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A

TREATISE

UPON

PENETRATING WOUNDS

OF

THE CHEST.

LANE LIBRARY

BY

PATRICK FRASER, M.D.,

KNIGHT OF THE ANCIENT AND MOST NOBLE ORDER OF THE TOWER AND SWORD;
HOLDER OF THE CRIMEAN MEDAL AND SEBASTOPOL CLASP, AND THE TURKISH WAR MEDAL, FOR
SERVICES IN THE CRIMEA; LATE PHYSICIAN EXTRAORDINARY TO HER MOST FAITHFUL
MAJESTY QUEEN DONNA MARIA OF PORTUGAL; LATE STAFF PHYSICIAN TO THE ARMY
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DEDICATED

(BY PERMISSION)

TO

THE RIGHT HON. LORD PANMURE,

K.T., G.C.B.

My Lord,

The act of dedication of this Treatise, which is founded upon actual observations made by me while I served in the Camp General Hospital before Sebastopol, is very appropriate.

Your Lordship was called to the important post of Secretary of State for War, at a period when the combined effects of privation, disease, and other disasters, had severely tried the endurance and the fortitude of the British soldiers engaged in the Crimean war.

Your Lordship had then the wisdom to propose, and the firmness to execute, the plan by which a staff of civil medical practitioners was dispatched to Scutari and the Crimea, to assist in the treatment of the sick and wounded men of the British army. The mission was executed with fidelity and zeal; and your Lordship has been pleased to express your satisfaction for the services rendered.

During your Lordship's administration, a healthful, and thereby invincible, British army arose! Victory and triumph became the reward.

I have the honour to be,
My Lord,
Your Lordship's humble and obedient servant,
PATRICK FRASER, M.D.

London, April 1859.

TO THE READER.

THIS Treatise was originally written with the intention of having it read before the Fellows of the Royal Medico-Chirurgical Society. This arrangement was frustrated; but the learned Council honoured me by publishing an abstract of the Treatise in the Proceedings of the Society.

Having considered that a certain value is justly attached to cases observed in the field, I thought it would be a pity that all record of the cases which had passed under my own care should be lost.

I present the cases, with observations, to my professional brethren as an instalment only, to be added to, amended, and improved by future and more talented observers, when again is sounded "War's deadly blast".

I have been further interested in this publication by observing that in "The Medical and Surgical History of the British Army during the War against Russia" only twenty-one cases and the histories of twelve are given of "gun-shot wounds of the chest"; and among these not one of any [illegible] appears. This omission is explained, I believe, by a great portion of the official records of the "Army General Hospital" having been lost. The actual number was nevertheless obtained; and therefore the Director-General's statistics are correct.

I have been unable, from the jealous exclusiveness of the French authorities, to procure the necessary data to complete Table II, page 6; nevertheless, the information which the Table conveys, even in this imperfect state, is highly interesting and curious. Since the sheet containing the Table has been printed, I have procured from the Director General's Report a statement of the number of "chest wounds" from sword, bayonet, etc., as follows: "Among the men, sword and lance wounds, none; bayonet wounds, eleven; of which two died; six discharged to duty; three invalided. Among the officers, none." With this addition, the statistics of chest wounds in the Crimean war are completed.

In referring to "The Medical and Surgical History of the British Army", I take the opportunity to remark that, whatever defects may, perhaps unavoidably, have obtained in the Army Medical Department, this History is a practical proof that great individual talent and industry are to be found among my military professional brethren: and I firmly believe that, if the advice of the members of the Army Medical Department had been even in part followed, and not, as it was in many instances, entirely ignored, the extent of the Bulgarian and of the Crimean disasters would have been much diminished.

I look forward with sanguine hope that the time is not far distant, when the army medical man will have a direct authority to carry out the best means for the prevention of disease in the soldier; seeing by Table II, page 6, the more than decimation of troops caused by disease alone, compared to which the number of deaths actually on the field of battle, and from the after effects of wounds, sinks into utter insignificance. The saving both in life and money to the country, in that very expensive article the British soldier, will be greater when this auspicious time arrives, than many suppose. This saving, however, can only be ensured when the authorities in the Army Medical Department are permitted to have an imperative voice in selecting the locality, and in the construction, the ventilation, the drainage, and sewerage of barracks and encampments; and in the equally important matters, the character of the clothing, the food, and the movements of the troops in time of peace; and to advise with a fixed authority, provided strategic reasons do not interfere, in all hygienic measures calculated to sustain the health and efficiency of an army in the field.

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CHAPTER I.

INTRODUCTORY NOTE.

In Pope's translation of the *Iliad*, there may be read the following words:—

> "Full on his breast the Trojan arrow fell,
> But harmless bounded from the plated steel."

This sentence, considered in relation to our subject, is of interest, as showing that, in ancient times, from the protective armour worn, and the kinds of weapons used, wounds of the chest would be of rare occurrence: it possibly explains the reason, also, why we have no records of the effects produced by, or the treatment adopted for, wounds of the lungs, either from javelins, spears, or arrows, in the wars of the primitive ages.

The employment of gunpowder in warfare in 1346, in which year large guns were used at the

CHAPTER II.

THE QUESTION OF MORTALITY.

In the attempt to arrive at a useful conclusion on the question of the mortality incident to penetrating wounds of the chest, I have before me the documents in the Director General's office, and other statistics from various sources. Referring to the first of these sources of information, I find the singular fact, that out of the grand total of wounded throughout the Crimean war, viz., 12,094, only 164 are returned under the head of actual lung wounds, being 1·35 per cent. of the total number wounded, as may be seen by the annexed Tables, Nos. 1, 2 and 3:—

TABLE I.[*] GUN-SHOT WOUNDS OF THE CHEST.

Return, showing the Number and Results of the Cases treated from 1st April, 1855, to the end of the War.

NON-COMMISSIONED OFFICERS AND PRIVATES ONLY.

		Died.					
	Total treated.	In the Regimental or Primary Hospitals.	In the Secondary Hospitals.	Of other diseases while und. treatm. for wounds.	Total died.	Discharged for duty.	Invalided or transferred.
1. Simple flesh contusions and wounds .... Slight	143	—	—	—	—	135	8
Severe	112	1	1	1	3	77	32
2. With injury of bone or cartilage, without known lesion of contents and not opening the cavity....	24	—	1	—	1	11	12
3. With lesion of contents, but not opening the cavity	16	9	—	—	9	3	4
4. Penetrating the cavity, and missile lodged, or apparently lodged	33	28	3	—	31	—	2
5. Perforating, or apparently perforating, the cavity Superficial	9	2	1	—	3	—	6
Deeply....	83	68	3	—	71	—	12
Total..............	420	—	—	—	118	226[†]	76

Return, showing the Number and Results of the Cases treated during the entire War.

COMMISSIONED OFFICERS ONLY.

	Total treated.	Total died.	Discharged for duty.	Invalided or transferred.
1. Simple flesh contusion and wounds Slight	11	—	7	4
Severe	14	—	5	9
2. With injury of bone or cartilage, without known lesion of the contents, and not opening the cavity	6	1	—	5
3. With lesion of the contents, but not opening the cavity	1	1	—	—
4. Penetrating the cavity, and missile lodged, or apparently lodged	8	7	—	1
5. Perforating, or apparently perforating, the cavity................. Superficially	1	—	—	1
Deeply	13	8	—	5
Total.........................	54	17	12[†]	25

---

[*] The Tables date from the 1st of April, 1855, to the end of the War; peace was proclaimed on the 30th of March, 1856. Previously to the 1st of April, 1855, no reliable data exist. The Tables, therefore, include a period of 364 days. In Table No. 1, Sections Nos. 3, 4, and 5, are the items to be dealt with strictly in this Treatise.

[†] In estimating the mortality, it must be remembered that the number, as given in Table No. I, must be taken with the qualification that out of the number discharged for duty, viz., 238, the number of 71 were shortly discharged the service, a certain proof of the extensive damage done, and, probably, a prelude to death from the effects of the original wound.

This Table, showing the number of Deaths from all causes, and
statician, although

Total Number of Men sent to the East.	Total killed in action.	Per cent. to total strength.	To strength of officers and men.	Total deaths from wounds.	Per cent. to total strength.	To strength of officers and men.	Total deaths from disease.
ENGLISH.							
Officers . 3,905	86	0·09	2·20	157	0·16	4·02	143
Men . . . 90,054	2,598	2·7	2·88	1,761	1·87	1·95	16,155
Total . . 93,959	2,684	2·76		1,918	2·0		16,298
FRENCH.							
Officers	325	0·10		115	0·03		
Men	7,182	2·32		3,866	1·25		
Total . 309,268	7,507	2·42		3,981	1·20		57,741

TABLE III.

Showing the Ratio of Chest Wounds in Officers to Men.

	Officers.	Men.
All chest wounds to total number wounded . .	0·50	3·50
Actual lung wound to total number wounded	0·18	1·16
Mortality of all chest wounds, whether penetrating or not	31·50	28·09
Mortality of actual lung wound	69·56	80·85

But if the *whole* statistics of the battle-field were ascertained, it would be found that a large, if not the largest, proportion of mortal wounds proceed from injuries to the lungs and large vessels. The men are struck down, and die, more or less rapidly, on the field of battle, from hæmorrhage and suffocation, and [illegible] knowledge as to the exact character of the [illegible] lost [illegible].

If it were not [illegible] cial staff of medical me[illegible] *ded, throughout the Crimean War, is given as interesting information to the rtaining to the subject of the Treatise.*

	Per cent. to total strength.	To strength of officers and men.	Total deaths from all causes.	Per cent. to total strength.	To strength of officers and men.	Number wounded to total strength.	Per cent. to total strength.	To strength of officers and men.	Number of deaths to total wounded.	Per cent. to total wounded.	
			386	0·41	9·88	579	0·61	14·82	157	27·11	
			23,112	24 6	25·66	11,515	12·25	12·78	1,761	15·29	
8			23,498	25·0		12,094	13·0		1,918	15·80	
						1,625	0·52		115	7·07	
						35,912	11·28		3,866	10·76	
			69,229	22·38		37,537	12·13		3,981	10·60	

circumstances similar to those in which the army was placed before Sebastopol, or in any standing camp before an enemy, to ascertain the kinds of wounds which kill on the field. Such information as we have on these points is certainly very small. M. Scrive, from extensive data, gives the following statement, showing the ratio of wounds received in different parts of the body at a siege, to an engagement in the field :—

	Head.	Chest.	Abdomen.
Siege....	1 in 3	1 in 12	1 in 15
Field....	1 in 10	1 in 20	1 in 40

When the substance of the lung is actually wounded, recovery is not so frequent as many suppose. The ancients were less sanguine in this matter than are the moderns. Galen (lib. v, cap. 26) pronounces deep wounds of the lungs fatal. Arceus says "The common opinion of almost all our writers is, that wounds received in the deep breast are for the most part incurable." Wiseman, at p. [illegible], writes, "almost all those wounds made by gun-shot are mortal"; and at page 436, "many instances may be given of gun-shots in the breast, but few do recover that are shot in the lungs." Hecker thinks that lung wounds are very fatal.

Harald Schwartz expresses even a stronger opinion at page 114 of his *Beiträge zur Lehre von den Schusswunden*. John Fagaultii says, at page 52: "Vulnera autem quæ pulmonibus accidunt, ideo curatu sunt difficillima, imo magna ex parte insanabilia." Plenck says: "Magna pulmonis vulnera absolute lethalia sunt." But, as it seems, writers are not agreed on this point, and it is established, that wounds at or near the apex of the lung are more likely to be attended with unfavourable results than wounds at the base of the lung, partly from the more profuse hæmorrhage, and partly from the less easy exit for blood. There are, on the other hand, cases in which recovery has taken place when the substance of the lung was wounded. A case is noted in the first volume of the *Edinburgh Medical Journal*, page 360: "A man was stabbed in a drunken brawl, and a portion of the lung protruded, became strangulated, and was cut off. No urgent symptoms appeared at any period, and recovery was perfect."

Hennen states, at page 390, of his *Military Surgery*, "I have seen many wo[illegible] thorax, both from pike, sabre and gun-shot, do well ultimately." Dr. Gregory says, that "of twenty-six wounds of the thorax received at the battle near Quebec, two only were fatal." Dr. Houston concludes, "all wounds penetrating the cavity of the thorax, so as to admit air, are not certainly, nor instantly, fatal, unless their apertures exceed that of the glottis." John Bell, at page 297, writes, "Wounds of the substance of the lungs are far from being mortal." Guyon gives thirty-nine cases of *cure* (?). Bernhardo Suevo, Ruysch, Tulpius, Fallopius, Houstius, Arcæus, Schenkius, and Dufouart, give cases of cure.

On these points, I am able to supply the following statistical details :—

TABLE IV.

STATISTICS OF WOUNDS OF THE CHEST.

Total Number of all Wounds, 12,094, *in the Crimean War.*

	Cases.	Per Cent
TO TOTAL NUMBER WOUNDED.		
Percentage of all chest wounds to total number wounded	474*	3·90
Percentage of actual lung wound to total number wounded	164	1·35
Mortality of all chest wounds to total number wounded	135	1·11
Mortality of actual lung wound to total number wounded	130	1·07
TO TOTAL STRENGTH.		
Percentage of all chest wounds	474	0·54
Ditto of actual lung wounds	164	0·17
Mortality of all chest wounds	135	0·14
Ditto of actual lung wound	130	0·13

---

* T[illegible] ber ought properly to be added 153, being the number of ch[illegible] eceived during the first period of the war, of which 32 ar[illegible] have died, making a grand total of 627; but as the

	Cases.	Deaths.	Per Cent.
Mortality of all chest wounds	474	135	28·50
Ditto of actual lung wound	164	130	79·26

TABLE V.

Showing the Number of Chest Wounds on the occasions named, and from the Authorities quoted, with the percentage of Deaths to Wounded.

Actions, &c.	Wound.	Died.	Per Cent.
The Director-General's Records prior to Crimean War	39	27	70·00
Crimea	474	135	28·50
Simpheropol (Russians)	200	137	98·05
Toulouse	106	50	50·00
Quebec	26	2	7·07
Carlist War	29	27	100·00
Paris, 1830	20*	10	50·00
Ditto, 1848	9	4	44·00
Ditto, 1850	11	5	45·50
Battle of Kilet	21	11	50·00
„ Idstead	97	17	17 00
„ Canton	4	4	100·00
M. Meniere	20	20	100·00
M. Legonest	6	3	50·00
Guy's Hospital Reports	72†	9	12·50
Danish War; Report of Chief-Surgeon Schytz. Total wounded, 227	10	2	20·00
Dr. Kidd	36	24	66·00
	1,180	547	

It is more than probable that many of the cases were wounds of the pleura only, and that the alleged wonderful recoveries from actual wounds of

---

data for the first period of the war is uncertain, the number has not been admitted into the calculations.

[*] De Lambale and Baudens.

[†] Of this number, the lung was really wounded in two cases only.

the lung would have been disproved, if at death an examination had been performed. M. Baudeus, at page 226 of his *Clinique*, fully recognises this fact.

I venture to doubt even the evidence of the celebrated Larrey upon this point. He gives five cases of wounded in the lungs during the fights in July 1830. What is his proof? "Ce que s'est caracterisé par le passage, au dehors de l'air mêlé au sang, l'expectoration sanguine et tous les signes de l'épanchement." The little value I place upon these signs will appear in the course of this Treatise. In my opinion, in only two of the five cases were the lungs actually wounded. On the other hand, however, a case is given by the same writer (page 225) which occurred during the war in Egypt, in which recovery took place, and there was no doubt that the lung was wounded.

In estimating from the symptoms whether the lungs be, or be not, wounded in any one individual case, we should remember that the lungs may be wounded, and the ordinary symptoms altogether absent, from the wound entering exactly at a spot where, from previous adhesions, the lung is so firmly glued to the thoracic parietes, that it neither collapses, nor can effusion take place, nor much blood nor air escape.

There is a case, however, mentioned in the *Medical Times*, of 20th August, 1847, of a stab wound, where it appears certain that the lung was wounded, and recovery took place: also, another case is recorded by Sir Everard Home, in the second volume of the *Medico-Chirurgical Knowledge Society*, page 169, where an officer was shot through the chest, and lived for thirty-two years afterwards. The *post mortem* examination showed that both lungs had been wounded. Dr. McLeod, in his notes at page 248, speaks of several cases of recovery. The following case, published in the *British Medical Journal*, of 15th May, 1858, probably has been cited as a case of cure :—

"William L., age 24, late a private in the 33rd Regiment, and who died in the University College Hospital, towards the end of April, 1858, was wounded in the attack on the Redan in September 1855, and when invalided, was considered a decided case of recovery from a wound of the lung. "The ball was found to have entered the left side, and wounded the lower lobe of the left lung, passed through the diaphragm, took a piece out of the anterior margin of the spleen, passed behind the pancreas, across the left kidney, and through between the supra-renal capsule and kidney, without injuring either, and into the vertebral column, scraping a piece out of the vertebra, turned a little forward, passed close to, and behind the aorta, and finally lodged behind the vena cava." It was noticed that the wound in the diaphragm had not healed. The preparation is in the University College Museum, and a careful inspection has been made of it. It may well be doubted whether the substance of the lung had been wounded: at all events, the injury must have been very slight, in fact, merely marginal. It is probable that the slight laceration visible may have resulted in the act of removing the lung from its cavity, it having been strongly adherent.

A remarkable case occurred, in the Regimental Hospital of the Grenadier Guards, under the care of Mr. Blenkins. The ball entered near the angle of the right scapula, and made exit at the sternal end of the clavicle. It had passed through the apex of the lung. A deposit of lymph was seen in the track. A complete circumscribed pleuritic adhesion had been formed near the wound, separating the diseased from the healthy structure. The ball had passed between the subclavian artery and vein, wounding the latter. Phlebitis ensued, and except from this untoward occurrence, Mr. Blenkins considers that the wound of the lung would have healed.

The older writers held in great dread an opening into the pleural sac, and viewed that event as almost certainly fatal, thinking that it could scarcely occur without the lung also being wounded. I am satisfied that the lung frequently escapes in penetrating wounds of the chest, and that a simple wound of the pleura is not of necessity productive of dangerous consequences, unless under circumstances to be hereafter mentioned.

Several of my cases and experiments show this; and an experiment by Hewson, at page 296, is well in point: "I fractured the chest of a rabbit, but so cautiously as not to hurt the lungs; and having blown into the chest, I immediately made a compression upon the wound with some lint, a compress, and a bandage, in order to confine the air in the cavity of the thorax. I then observed that the animal breathed more frequently and laboriously; on removing the compress, the air rushed out, and the animal gradually recovered its natural manner of breathing. In a few days, it was perfectly well."

In concluding this chapter, I cannot but remark on the fact of the small number of penetrating wounds of the chest recorded in our English periodical literature. Thus, in Table No. 6, I have given, I believe, all the cases reported in the *Lancet*, *Medical Times*, *Medical Gazette*, and *Medico-Chirurgical Transactions* from their commencement.

TABLE VI.

Showing the Number and Dates in which Cases are recorded in various Periodicals.

The LANCET:

August 11....	1832	page	604
October 27....	1832	,,	159
June 2	1838	,,	350
August 14....	1841	,,	724
May 9	1846	,,	533
January 9	1847	,,	67
April 6	1851	,,	416
February 14 ..	1852	,,	193
June 21	1856	,,	682
,, ...	,,	,,	685

The Medico-Chirurgical Transactions :

Vol. VII......	1825	page	315
Vol. IX.......	1826	„	204
October	1841	„	564
„	1842	„	615

The Medical Gazette :

March 29	1828	page	512
October 24....	1829	„	124
January 16 ..	1830	„	520
May 2	1835	„	146
November 18..	1837	„	302
August 18....	1838	„	802
February 7 ..	1840	„	721
May 20	1843	„	322
September 26 .	1845	„	980
January 22 ..	1847	„	1362
March 16	1940	„	483
October 18 ..	1850	„	713

The Medical Times :

April 6	1844	„	21
December 7 ..	„	„	231
August 20....	1847	„	512
April 8	„	„	
December 17..	1853	„	638

The Medical Times and Gazette :

Vol. XXXVI ..		page	242
„		„	604

No less remarkable is the small number of preparations of lung wounds to be found in our Hospital Museums. For example; at the College of Surgeons, there are but 7; at St. Thomas's Hospital, 3; at St. George's, 2; at University College, but 1; and at Chatham Museum, not one.

CHAPTER III.

ON THE DIAGNOSIS AND PROGNOSIS OF PENETRATING WOUNDS OF THE CHEST.

THE sources of my information on these points, are:

1. Various recorded cases.
2. Cases under my own observation.
3. Comparative experiments.

Wounds of the chest may be classified as follows:

1. Simple contusion of thoracic parietes.
2. Dialysis of the soft parts by gun-shot or cutting instruments.
3. Ball impacted, but not entered.
4. Ball impacted, costal pleura wounded.
5. A rib or ribs, sternum or clavicle fractured, with or without protrusion of the unwounded lung.
6. Ball entered, and passed out.
7. Ball lodged.
8. Both pleuritic coverings and lung wounded.
9. Lung ruptured, thoracic parietes and pleuritic coverings, not wounded.
10. Lungs, pleura, and diaphragm wounded,

with or without the presence of spiculæ, or other foreign body.

11. Rupture of an intercostal, a mammary, or other artery.

When a man is struck down, by a penetrating wound in the chest, and without delay placed before the surgeon, there is often little or no anxiety, dyspnœa, or other urgent symptom; this immunity from suffering is remarkable, on occasions, when the conclusion is, that a certain amount of damage has been incurred.

This is shewn in the following cases:

Case 19. James Anderson, age 24, 44th Regiment, wounded on the 18th June. Ball entered between the ninth and tenth ribs of right side posteriorly. Exit at three inches from umbilicus of same side. Another ball passed through right biceps muscle, fracturing the humerus.

This patient was treated at first with calomel and antimony. No lung symptoms appeared; and in the month of November 1855, he was suffering from the wound in the arm only.

Case 20. A. Scannal, age 24, 44th Regiment, was wounded on the 18th of June. Ball entered anteriorly at the fourth right rib. Exit at the inferior angle of the right scapula; great depression; ordered salines, beef tea, and absolute rest.

28th. Pulse 72; respiration 28; absence of respiratory murmur, and slight dulness upon percussion of the base of right lung.

8th July. Respiratory murmur heard at base of right lung, and no dulness upon percussion.

24th. To duty.

Case 21. J. Jenkins, age 21, 38th Regiment, wounded on the 18th of June. Ball entered between the sixth and seventh right ribs. Exit between the ninth and tenth ribs of same side. Dulness upon percussion, and absence of respiration at the posterior part of the right lung. No fever supervened, or any lung symptom; on the 8th of July, the respiratory murmur had returned, but there was dulness present on percussion.

9th July. Tonics, chloric æther, and wine.

19th July. Respiratory murmur healthy throughout the lungs, but still slight dulness. Being extremely enfeebled by previous exposure, he was sent to England on the 27th of July.

Case 22. W. Halling, age 38, 18th Regiment, wounded on the 18th of June. Ball passed through biceps muscle of left arm, struck the thorax at the angle of the seventh rib, and passed out at the twelfth rib of same side, close to the spine. The pulse never rose above 80, and the respiration continued natural; slight dulness on percussion, and slight crepitation was perceived at the base of the left lung.

On the 10th of July, the auscultatory signs were healthy; complains of absence of sensation in the line of the twelfth intercostal nerve; and loss of motion in fingers of left hand. Sent to his Regimental Hospital.

CASE 23. J. Doherty, age 20, 18th Regiment, wounded on the 3rd of August. Ball entered at the anterior margin of right scapula. Exit at the seventh vertebra. No lung symptoms; loss of power in right arm. Ordered mild diet and rest. He had diarrhœa for a few days, which yielded to the ordinary astringent treatment; and he was discharged cured on the 7th of September.

CASE 25. John Mills, age 23, 97th Regiment, wounded on the 8th of September. Ball entered at the base of the right scapula. Exit at the sixth left rib, and passed through the right deltoid muscle. Pulse 92; respirations 28. Hæmoptysis. Ordered beef tea and absolute rest.

12th. Slight dulness on percussion posteriorly of left thorax. Pulse 68; respiration 20. On the 14th, the pulse rose to 84, and respirations 40; ordered salines. On the 6th October, discharged to Castle Hospital, at Balaklava, convalescent.

CASE 27. Patrick McDonough, age 23, 7th Regiment, wounded on the 8th September, by a grape shot, which entered at the left loin, passed transversely upwards, and made exit at the eighth left rib. This patient presented no lung symptom; on the 20th of September, the wounds being nearly healed, he was sent to his Regiment.

CASE 28. J. Brown, age 29, 23rd Regiment, wounded on the 8th of September. Ball entered at the third right rib, passed under the axilla, and made exit at the anterior edge of the right scapula.

Being very costive, ordered laxatives, low diet, and rest. Convalescence proceeded favourably, and he was sent to the Castle Hospital, at Balaklava, upon the 6th of October.

This absence of nervous anxiety, agitation, and general disturbance, is very remarkable when contrasted with the effects of wounds of the abdominal cavity. The alarm, and apprehension, however, when present, are very characteristic, and the most devoted courage and self-control seem to become powerless in resisting the effects of the hidden mischief of a gun-shot entering either of the cavities. The question arises, does the extreme anxiety generally produced by abdominal wounds, arise from the larger implication of the sympathetic system of nerves, compared with its lesser implication in lung wounds? In relation to the shock upon, or implication of the nervous centres in cases of lung wound, it is important to note the rarity of tetanus. In the Indian Reports, there is only one case of tetanus mentioned as supervening upon a penetrating wound of the chest. In Paris, during the revolution of 1830, out of three hundred and ninety gun-shot wounds, among which were twenty cases of lung wound, only one case of tetanus occurred; but *that one* was a case of penetrating wound of the chest, and was fatal. Twenty-nine cases are reported of tetanus in the Crimea, but no one from lung wound, except a case of "trismus" in a French soldier.

Blane, at page 555 of his work on the *Diseases of Seamen*, states that in the naval action, in April 1752, out of eighty-eight wounded, sixteen had tetanus. Larrey does not mention a single case. In the Danish war, out of nine hundred and twelve wounded, no case of tetanus occurred.

If there be a wound of entrance and exit, the fear of a lodgment of the ball may be dismissed; but there may be various extraneous bodies, such as fragments of cloth, leather, wadding, buttons, or other metallic substances, which had formed portions of the clothing or accoutrements of the soldier; there may be also portions of similar materials, as well as splinters of bone driven from adjacent wounded comrades. It may also happen, that a man may be struck by two balls, and both lodged; in such a case, the two apertures may mislead the surgeon. If there be a wound of entrance only, the presence of a ball or other foreign body may be suspected, but not affirmed, as it may have dropped, or been pulled out.

Many writers have discussed at great length the diagnostic signs of the entrance and exit apertures, formed by balls; the decision of this matter is in certain respects immaterial, as no very great, if any, modification of the treatment would result from a correct diagnosis on this point. This question can become of vital importance in medico-legal cases only. The evidence preponderates in favour of the wound of entrance being the largest;

reference may be directed to elaborate observations on this subject "faites à l'Académie Nationale de Médecine," by M. Huguier.

The character of the external injury having been observed, it is next to be ascertained if the substance of the lung has been wounded. A correct diagnosis on this point materially involves the prognosis. S. Cooper, at page 1193, gives as a mode for determining this question, "make the patient expire strongly; during the succeeding inspiration, as completely as possible cover the wound, to prevent the entrance of external air; after once or twice repeating this process, if air continues to be expelled, the lung must be wounded." This mode, admitting the theory to be correct, can scarcely ever be made satisfactory; for the external air must enter and, in spite of all obstruction, disturb the observation. To help us to a decision on this question, the various opinions held by physiologists, as to the effect produced on the lung, whether wounded or not, by opening the pleural cavity, will come under notice.

It is generally considered that the lung collapses, John Bell employs the term "*falling down*," whether wounded or not, whenever the pleural cavity is opened. The idea being, that the sudden application of the atmospheric pressure will be greater than the expanding power of the air entering by the trachea; and this opinion obtains some support from the fact, that the pleural cavity may be penetrated, and the lung be nevertheless untouched. At the commencement of my observations in the Crimea, I had in my memory the statement given by Dr. Hennen, at page 382 of his *Military Surgery:* "The sinking of the lung is not an uniform consequence of a penetrating wound of the thorax." I was prepared to witness this phenomenon, and to consider the non-collapse of the lung a proof that it had not been wounded. I was soon undeceived, and disappointed by stern reality.

The following cases, as also several of the experiments, No. 1, page 26, and No. 2, page 29, to be hereafter narrated, showed that the lung might be wounded, and the pleural cavity opened, and the lung remain uncollapsed.

CASE 2. J. McCartney, age 32, 18th regiment, wounded on the 18th of June. Ball entered between acromial end of left clavicle, and head of humerus, knocked off the corocoid process; entered thorax at and smashed the third rib, traversed portion of lung, passed through sternum at the junction of the second right costal cartilage, knocked off an inch and a half of sternum, wounded lung, and laid open anterior mediastinum, and made exit at the third right rib. This man was bled to forty ounces, and calomel and antimony administered.

22nd. Very weak. Intermit calomel and antimony. Had wine and mild diet; an opiate at night. On the 29th, diarrhœa appeared, which was checked by chalk mixture, creasote, and opium. Remained much the same until the 11th of July, when he expectorated a large quantity of mucopurulent matter. Upon coughing, air passed through the anterior opening; the lung *uncollapsed.*

16th of July. Died suddenly. Examination. Left pleural cavity contained nearly two pounds of coagulated blood. The source of this hæmorrhage not discovered; the lung substance, around track of wound, consolidated. The wound was perfectly isolated from the pleural cavity by adhesions. Stomach and mesenteric glands enlarged.

CASE 12. J. Size, age 26, 3rd regiment, wounded on the 8th of September. Ball entered posteriorly at the fifth left rib, close to spine. Exit above the left clavicle. Pulse 92, wiry; no dyspnœa; considerable hæmoptysis. Ordered a little wine and water, and absolute rest.

11th. General symptoms as above. Crepitation throughout, and comparative dulness on percussion over left lung; ordered two grains of calomel, and half a grain of opium every third hour.

12th. Pulse 120; respirations 36 per minute.

13th. Pulse 120; respirations 40. An enormous quantity of serum began to be discharged at posterior wound.

14th. Pulse 120; respirations 48. Gums a little tender, intermit calomel and opium.

15th. Pulse 120; respirations 60; great debility. Air rushed through both wounds during expiration. Enormous serous discharge from posterior wound.

16th. Dead. Examination fourteen hours after death. Fifth left rib fractured. Left pleural cavity half filled with bloody serum. The apex of left lung much congested, but not wounded, nor *collapsed*. A marked line of demarcation between the congested and normal portion of lung.

Case 15. G. H., struck down by a grape shot, on the 18th of June. No external wound, but the eighth and ninth left ribs were fractured. In a few days a small swelling appeared over the concussed spot; the skin shortly afterwards ulcerated, and a large quantity of bloody purulent matter continued to be discharged until death, on the eighth day.

Examination:—A rent of two inches long in the lung, at a point corresponding to the seat of the concussion. No *collapse* of lung; no pleuritis; no sign of reparation. A fallacy may also arise, from a mechanical cause preventing collapse of the lung, as shown in the following case.

Case 4. J. McKenna, age 18, 77th regiment, wounded on the morning of the 27th of July, while in the trenches. Ball touched upper edge of left scapula, fractured second rib, passed through apex of left lung, through second dorsal vertebra, without injuring the cord, entered right pleural cavity, passed through apex of right lung, struck second rib, fractured it, and finally dropped on the [illegible] The lungs did not collapse, and [illegible] dyspnoea [illegible]. The left side was [illegible]. The lungs collapsed [illegible]

Similar experiments had previously been made. but for a different purpose, by Van Swieten, Dr. Hales, and Dr. Hondley, and recorded in the ninth volume of the *Philosophical Transactions;* also by Professor Gräfe, reported in the *Lancet* of 4th May, 1828.

I beg here to express my best thanks to Dr. B. W. Richardson, for valuable and able assistance freely given in the conducting of the experiments to be hereafter given. These experiments will be found to illustrate several disputed physiological points not strictly connected with my subject. I am indebted also to the same gentleman for many valuable opinions and suggestions, which have been freely incorporated with this Treatise.

CHAPTER IV.

(ON THE DIAGNOSIS AND PROGNOSIS OF PENETRATING WOUNDS OF THE CHEST CONTINUED.)

THE cases and experiments given in the previous chapter showed that a pleural cavity may be opened, and the lung, nevertheless, remain expanded.

When in the Crimea, I was unacquainted with, and had no means of reference to, the various ingenious explanations given, by several writers, of this fact. Cruveilhier had shown, in experiments, the non-collapse of the lung in wounds of the thorax; and several cases have been mentioned by different writers, one, in particular, by Dr. M'Ewen, in vol. [illegible], p. 368, *Medical Times*. Cases which have been called "hernia of the lung", related by Tulpius, Rolandus, Sabatier, S. Cooper, and others, may be placed under this category.

The question remains unsettled, whether the pleura pulmonalis and costalis, in a normal state, are always in immediate contact. If they are not always in immediate contact, there must be gaseous matter in the pleural cavity. It has been noticed in cases where the operation of paracentesis thoracis has been performed, that if the canula be left in, the trocar will be forced out, evidently by the pressure of air or gas from within. Dr. Hales, in his *Vegetable Statics*, has given two experiments (Nos. 112 and 113), which tend to show the presence of air. The reports of many cases of thoracic wound, in which the lungs have marvellously escaped, can be only accounted for by the pleura not being always in contact. The following experiments illustrate this point, in both stab and bullet wounds.

Experiment 2. A bistoury was plunged, by the lateral diameter, three inches into the right thoracic cavity of a small dog: he showed no signs of uneasiness, and the respiratory murmur continued distinct on the wounded side.

He lived for twelve days, and did not appear to die from the effects of the wound, but more from general weakness, not having been in health at the time the experiment was performed.

The examination displayed no signs of pleuritic or pneumonic inflammatory action. The lung of the wounded side did not collapse until the anterior thoracic wall was entirely removed, when both lungs collapsed. There was seen, in the upper lobe of right lung, a fissure, or rather a scratch, about two inches in length, and two lines in depth. Across this fissure lay a thin membrane, except at a small point in the centre, at which point the real lung substance was visible.

Experiment 3. Upon the 16th February, a healthy dog was tied down to a table, and, without narcotising, a spear was passed through between the fifth and sixth ribs, of right side, close to the sternum, until it appeared between the above named ribs, close to the spinal column. A whizzing of air entering was heard at the moment of penetration. No pain or inconvenience seemed to arise. The respiratory murmur was distinctly heard, not in the least impaired, on placing the ear upon the chest. Upon expiration, bubbles of air, mixed with blood, passed out at the entrance aperture; and a slight emphysema, or a bulging out of the skin, appeared at exit aperture. He died next day. On examination, the lungs collapsed upon opening the thorax. No effusion, or any sign of inflammatory action.

The spear had passed through, very superficially, the edge of the middle lobe of right lung, and had left merely a small dark spot of congestion at the points of entrance and exit; but no track of the transit of the spear between these two points was visible. Upon inflating the sound or left lung, and then suddenly pressing out the air, at the same moment strongly closing the trachea, the air passed rapidly into and distended the right lung. The air did not escape at the supposed wound.

Experiment 4. On the 19th of February, 1858, a healthy dog was tied down to a table, and a spear was passed into the right thorax, close to the sternum, between the eighth and ninth ribs, and out close to the spine. Four ounces of blood escaped by anterior wound. Respiratory murmur equally inaudible on both sides. On the 23rd February, the dog ate and drank, and was very lively. Respiratory murmur audible on both sides.

1st March. Has remained healthy, and showed no sign whatever of having been wounded. Destroyed by half a drachm of prussic acid.

Upon examination, the wound of entrance was not visible; the wound of exit was visible from within, and was about two inches in length. Both lungs collapsed on raising the sternum.

No effusion in either pleuritic cavity.

Right lung bound posteriorly to the walls of the thorax, the posterior mediastinum, and the diaphragm.

These adhesions were carefully detached, and the lungs and heart taken out. The right lung was felt to possess the normal vesicular crepitation upon pressure. Upon its upper and middle lobe were three separate patches of highly congested lymph, about an inch in diameter; each patch joined to its fellow by a bridle or narrow band also of highly congested lymph. It was doubtful whether the wound of exit was not more or less plugged up by this effused lymph. The place of these deposits corresponded with the points of adhesions previously mentioned. The nozzle of a pair of bellows was firmly inserted in the trachea, and upon using the bellows both lungs became fully inflated, and, taking care to effectually compress the trachea, they remained so after ceasing the inflation. It was certain that there was no escape of air by the wound. The patches of lymph were now carefully dissected off, and a most careful examination made, but no injury to the lung was seen. On cutting into its substance, every part was found healthy.

Experiment 5. On the 1st of March, shot a dog with a minié bullet, through the right side. He remained alive until the morning of the 4th, without apparent suffering. Upon examination, the bullet was found to have entered at, and fractured the fifth rib, skirted, without having actually wounded upper and middle lobe of right lung; bruised, but not entered pericardium, and passed out at second left rib, close to sternum, and was found within the skin close to middle of humerus. Upon examination, there were seen several recent pleuritic adhesions, and some of these adhesions had partially closed the wound of entrance in right pleural cavity. Several marginal portions of upper and middle lobes of right lung were condensed into a black mass, resembling the congestion caused by a bruise. On being cut into, the surfaces were moist, and no appearance of lymph. These dark portions sank in water, and were not, by pressure, made to float. The left pleural cavity was found filled with bloody serum, and had not been entered by the ball. No signs of pleuritis in this cavity. Both lungs remained fully distended after artificial inflation, and when the trachea was tied, did not collapse under pressure. Heart filled with fibrinous clots and dark coloured grumous blood.

Dr. Houston, in the ninth volume of the *Philosophical Transactions*, page 138, gives the following experiment; both sides of the thorax were opened in two puppies, " so as," he adds, " to discover the lungs on each side, but which did not however subside, but rather seemed to thrust themselves outwards." Dr. Van Swieten performed the following experiment, as related in the same *Transactions*, page 139: " A middle sized dog was tied to a board, and his thorax was opened on both sides, with a large wound. His voice did not fail, and the lungs were so far from collapsing, that a lobule of them thrust itself through each aperture."

The following experiments, Nos. 6 and 7, corroborates the foregoing statements. The right pleural cavity of a healthy dog was carefully opened, so as to avoid wounding the lung; the same phenomena were witnessed as in No. 3, viz., air passing in on inspiration, and out on expiration. After death, having removed the whole anterior wall of the thorax, the lungs were fully exposed; upon artificially inflating the left lung, and then strongly compressing the trachea, the right lung having previously collapsed; and then pressing so as to empty the inflated lung, the air passed rapidly by the bronchial communications into the other lung, and fully inflated it.

Experiment 7. On the morning of the 1st of February, 1858, a healthy dog was put into a properly adapted case, with a glass slide, and placed under the influence of "puff-ball." A portion of the fifth right rib was then dissected out, sufficiently large to bring the lung into view, having carefully avoided wounding it. The lung was then distinctly seen to contract upon *inspiration*, and to expand upon *expiration*.

Various writers have offered explanations of this curious phenomenon. Dr. Hales, in his *Statical Essays*, page 74, in writing upon this point, would lead us to infer that he considers this expansion of the lung to proceed, when there is an opening on one side only, from the force of the blood, in the pulmonary circulation, dilating the lung.

Dr. Hoadley, in his *Three Lectures on the Organs of Respiration*, in 1737, when reasoning upon the experiments of Dr. Houston, explains the phenomenon as follows:—"In expiration, the air in the unwounded side was condensed, and part of it, instead of going out at the windpipe, forced its way into the lung of the wounded side, and dilated it, till the air within it came into an equilibrium with the external air which surrounded it; and in inspiration, when the air in the lung of the unwounded side became rarer than the external air, the lung in the wounded side was compressed, and part of the air within it was, by the pressure of the external air, forced back into the lung of the unwounded side, till the equilibrium was again restored."

From the foregoing, we may infer that Dr. Hoadley considered the action of the lung, after an opening into the thoracic cavity, to be owing to the varying elasticity of the air within that cavity.

An explanation is also given by Dr. Halliday, in his *Observations on Emphysema.* He says,—"Should, however, the patient, in making an effort to expire, contract the glottis, the air contained in the lung of the sound side, meeting with no resistance, will, by the communication of the branches of the trachea, expand the lung of the wounded side, so as to cause it to protrude at the wound."

The above explanation by Dr. Halliday appears to me to be the best and most simple; and perhaps a more acute observation, if it were wholly true, was never penned in the form of a physiological explanation of a practical fact. But, nevertheless, it does not explain the whole case, for it requires a "contraction of the glottis." Now the phenomenon in question constantly happens when there is no contraction of the glottis.

If it be granted that the lung may be wounded, and yet appear uncollapsed,—I say appear uncollapsed, because the inflation is not the effect of natural respiration, but the consequence of a spasmodic closure of the glottis at the moment of expiration,—we may take it as a rule that in a penetrating wound of the chest the lung will sooner or later collapse, unless the inevitable consequences of the wound be happily arrested by treatment. This collapse will always be in a time proportionate to the relative size of the opening or openings. If the opening or openings be smaller than the glottis, the collapse will be slower; if larger, the collapse will be more rapid: and, in an imaginary increasing opening, the time will arrive when the collapse will be instantaneous. The openings caused by Minié balls are generally larger than the glottis; hence, doubtless, one great cause of the high rate of mortality, alike in the field as in the hospital, in cases of penetrating wounds of the chest.

CHAPTER V.

ON THE DIAGNOSIS AND PROGNOSIS OF PENETRATING WOUNDS OF THE CHEST (CONTINUED).

THE theory of Dr. Hoadley is ingeniously explained by a drawing of a machine, accompanying his Lectures. The machine consists of two square boxes of equal size, divided by a partition. The two boxes represent the pleural cavities; the partition represents the mediastinum. To the inside of the top of each box is attached a bladder. The two boxes are connected together by means of a tube on the outside, to the centre of which is attached another tube. This tube represents the trachea. The two diverging tubes which lead into the bladders consequently represent the chief bronchus of each lung; and the bladders the left and right lung respectively. These tubes are fitted with stopcocks, so that the bladders can be inflated and emptied at pleasure. In the lower side or bottom of each box is a round aperture, furnished with a rim, to which is suspended a large cylindrical bladder, having a free communication with the air contained in the boxes. The whole apparatus being air tight, it will be evident that, by alternately compressing and relaxing the outer cylindrical bladders, an action similar to the motion of the lungs and costal walls during respiration will be produced. Apertures are formed also at the end of each box, also in the partition, and each aperture is provided with a revolving metal plate, constructed to regulate the admission of air; by this additional arrangement, it is easy to observe the counterpart action of the lungs when respiration is disturbed by the effects of perforations in one, or both sides of the thorax, or through the mediastinum.

A more simple, but not the less illustrative, apparatus may be formed by a pair of bellows. We have only to suppose the chamber of the bellows to be divided into two compartments, and each chamber provided with a bladder. The nozzle, made to communicate separately with each bladder, will represent the trachea. By alternately raising and depressing the handle, the full action of respiration will be imitated. By this simple contrivance the appearance of collapse of the lung or lungs, also of emphysema, also of the curious fact of the lungs expanding when the thorax contracts, and the lungs collapsing when the thorax expands, after a wound in the chest, may be plainly demonstrated.

The experiment No. 3, page 29, fully corroborates the occurrence of this phenomenon; but, on the other hand, experiment No. 8, page 39, tends to weaken the evidence in favour of Halliday's explanation: for admitting that, in this experiment, "a spasm of the glottis" was present, the question arises, Whence came the gas or air which inflated the right lung? seeing that the left lung was contracted, bound down, and disqualified to fulfil the necessary conditions; although it may be admitted that, even in a collapsed lung, a sufficient amount of air will enter to cause the protrusion.

I was unable to verify, in the numerous cases which came before me, the very remarkable fact, that when an opening, at least equal to, or larger, than the glottis, is made into the thorax, the lung, in the wounded side, expands on expiration, and contracts on inspiration, but this fact was proved most clearly in two experiments, No. 7, page 34, and in No. 8, as follows.

Experiment 8. An opening made, one inch and a quarter in diameter, between the fourth and fifth ribs, into the right thoracic cavity of a healthy dog, avoided wounding the lung, but brought it fully into view. It was now distinctly seen to approach the aperture upon the act of expiration. Made a similar opening into the left pleural cavity. This cavity was found filled with a yellow-coloured serum, which flowed out, and the lung was seen contracted, and bound down to the spine. The right lung was found to be perfectly healthy.

Having considered, from the state of the lung, that no further valid observation on our present subject could be made, we turned our attention to the heart.

We observed that the systole of the heart was sequential to inspiration. Upon the application of ammonia to the nostrils, the languid action of the heart was instantly increased both in strength and number; but the number of respirations remained the same. On passing the finger behind the heart, its impulse was felt equally on all sides, clearly showing that it is no "tilting up" which causes the external impulse. The cardiac action endured for an hour and a half after the animal had lost sensation.

It may be inferred, therefore, that in all the cases in which air passed through the wound, as it invariably occurred during the act of expiration, at that moment the lung, although unseen, did rise towards the aperture. See table, page 52, cases Nos. 2, 7, 11, 12, 14, 16, 30.

In Nos. 2 and 7, the lungs were wounded. In Nos. 11, 12, 14, 16, and 30, the lungs were not wounded. No reliable practical deduction can, therefore, I am sorry to say, so far at least as my cases go, be drawn from this very curious physiological fact.

Dr. Houston explains this phenomenon by referring it to the sudden diminution of the lower part of the cavity of the chest, occasioned by the strong convulsive contractions of the abdominal muscles. This explanation is unsatisfactory.

In offering an explanation, I take as granted that certain physiologists are right in assuming that the upper ribs of the thorax converge during inspiration; and that, during the same act, the lower ribs diverge; and that the intermediate ribs are raised during inspiration by the external intercostal muscles, and are depressed during expiration by the internal intercostal muscles. If such be the true mechanical action of the walls of the thorax, it may be supposed that, when a portion of the walls is removed, a certain effect, varying according to the extent and part removed, will be produced, and there will be a corresponding decrease of compressing power in the thoracic walls; this lessened compressing power will diminish the velocity of air issuing from the wounded lung through the trachea; and, consequently, the air rushing from the sound lung will more easily pass into the partially expanded and wounded lung. Another explanation may be given. There is, of necessity, air lodged in the opened thoracic cavity; and when the chest walls contract during expiration, this air will be forced to escape at the open wound, especially if there be no wound of the lung, and thereby bear to the aperture the buoyant, although only half-expanded, lung, and cause an appearance as if it were being actually inflated.

CHAPTER VI.

ON THE DIAGNOSIS AND PROGNOSIS OF PENETRATING WOUNDS OF THE CHEST (CONTINUED).

In pursuing the question of diagnosis and prognosis, those symptoms come to be considered which are generally accepted as, and by many writers affirmed to be, conclusive evidence of the substance of the lung having been wounded; premising with a few remarks upon the occasional eccentric course of balls, before discussing dyspnœa, hæmoptysis, emphysema, pneumonia, and, lastly, the passage of air through the wound or wounds. This division of the Treatise will be closed by a highly interesting and valuable table, at page 52, which will show at a glance the relative frequency of the foregoing symptoms in thirty cases, observed by myself, and in twenty-one cases given in the Director General's Report.

When a ball moving with a given velocity in a certain direction, meets with a second impulse, it will have its direction changed into the line of the diagonal of a parallelogram, the sides of which are formed by the direction of the first force, and the second impulse; and these foreign impulses being repeated, we can easily comprehend that a ball may be completely swerved from a straight course, and even make the circuit of the body.

A curious case illustrative of this point is given by Dr. Robinson, *Diary of the Crimean War*, page 376. "A young soldier, imprudently trying to clean the nipple of his firelock, which he supposed to be obstructed, it went off, and the contents passed into an adjacent tent, shattering a poor fellow's arm so high up, that I was compelled to remove it at the shoulder joint. The wooden stopper of the firelock, a kind of peg covered with metal, had passed through the lower part of the arm, causing no dangerous injury. But the bullet following would appear to have struck the former, been turned off in its course at an acute angle before entering the arm, passed to the top of the shoulder at the inner side, then through the arm, shattering the bone, and finally lodged on the outer side."

There may be two openings so accurately corresponding in direction, that a strong conviction will immediately arise in the mind of the surgeon, that a direct passage through or across the thorax has been formed. There may even be two openings, and each opening have been caused by the entrance of two different balls, and both may be lodged.

Conclusions based upon the apparent course of the ball may be therefore fraught with disappointment to the surgeon, and danger to the patient.

Dupuytren says: "Il arrive qu'une balle traverse la poitrine de part en part sans blesser les poumons."

Hennen, in his *Military Surgery*, at page 372, says: "A ball may make the circuit of the lungs, without injuring the organs, and give the appearance of the man having been shot fairly across the chest. The bloody sputa seems to prove the fact."

In Hennen's day, the bullet of the "Old Brown Bess" was the perforator, and its course was often circuitous; but even the decisive conical rifle ball is not always thoroughgoing. A Minié ball may be so swerved, that, however specious the appearance may be, the pleura even may not have been entered, and in many cases the lungs most certainly not wounded. The pleura pulmonalis appears to possess a resilient power. A case, which came under the care of Mr. Hulke, where the lung was actually torn, and the pleura intact; also a case in the *Lancet*, 10th May, 1834, page 234; also several of my own cases and experiments, and cases related by Ballingall, *Outlines of Military Surgery*, page 306, are all corroborative.

In estimating the diagnostic value of the so-called symptoms attending lung wounds, we shall previously quote an Experiment to show that in a stab wound of a dog, few or no symptoms arise.

Experiment 9. The chest of a dog was obliquel transfixed with a bayonet-shaped stilette, between the fourth and fifth rib of the right side, close to the sternum, and passed out between the same ribs, near their angles. Air was heard to enter the chest with the point of the weapon. No dyspnœa, hæmoptysis, emphysema, or any febrile condition supervened, and the dog survived until the fourth day, and then died from exhaustion. The right lung was found collapsed, and perfectly blanched. A small wound was seen in the upper lobe of it, around which, to the extent of two lines, was a dark congested border. The lungs were carefully removed, and by aid of a pair of bellows were, through the trachea, gently but fully inflated. The left lung obeyed the expanding force, but the right could be inflated only very imperfectly; the air escaped with a hissing sound by the small wound. On repeating this procedure, but filling the left lung only, and firmly pressing upon the right, and then tying the trachea, the air from the fully inflated left lung suddenly rushed into the right, the pressure having been removed from it, and passed out at the wound.

We now proceed to analyse the value of *dyspnœa* as a sign of lung wound.

1st. DYSPNŒA. This is most fallacious as a sign of chest wound; it may be most intense from moral, or other [illegible] when the lung is not wounded; [illegible] altogether absent, when the lung [illegible]. If the lung be impeded, in following the chest wall, from any cause whatever, and entirely independent of a wound, there may be more or less dyspnœa. Our view of the cause of dyspnœa is, that it arises from the lung being hindered, from any cause, in following up the expanding and uninjured chest wall.

Dyspnœa will be most intense when the action of the thorax is free; and when, from obstructions in the bronchial passages, the air cannot reach the vesicles, so as to expand the lung to the full extent of the thoracic cavity. But when there is an opening in the chest wall, so that air can enter in or pass out by an abnormal channel, the lung having collapsed, there will be no opposition offered by the collapsed lung, and consequently there will be no dyspnœa. As exemplifications of this fact, we may notice the nearly total absence of dyspnœa in many cases, when we know that the lung is bound or pressed down to the spinal column, as in empyema; and in other cases when the lung is completely solidified, as a consequence of pneumonia; so that, the mere absence of air from the lung vesicles is not the cause of dyspnœa, but the mechanical conditions now noted are required. If this be the true explanation, dyspnœa must be received with great caution as a proof of lung wound.

The tabular statement at page 52, will, as already stated, show the comparative frequency of this symptom, as also of all the other symptoms under notice.

We see by this table, that out of nine cases in which the lungs were wounded, only three had dyspnœa, namely, case 4, page 25, and the two following cases.

CASE 5. James Fitzgerald, age 35, 9th Regiment, wounded on the 8th September.

Ball entered at the angle of the left scapula. Exit at the anterior margin of left axilla. On arrival at the hospital, pulse was 130, small, and thready. Respiration 30 per minute. Ordered beef-tea, with a little wine and water, and absolute rest. On the 11th, hæmoptysis was present, and slight emphysema around the left mamma; skin rather hot. Ordered a saline mixture, containing a quarter of a grain of antimony, every third hour.

13th. Skin cool; pulse 104; respiration 32; hæmoptysis diminished.

On the 15th, copious hæmoptysis suddenly reappeared; pulse 128; respiration 48; dulness on percussion, and crepitation of left side.

Died on the 16th.

Examination twelve hours after death. Ball fractured first and fourth left ribs, passed transversely through lower portion of upper, and upper portion of lower, lobe of left lung. The two lobes of left lung closely adherent. The portion of lung which surrounded the track of the ball was congested, almost to a state of hepatisation, to the extent of an inch and a half. Intercostal spaces much congested. No appearance of any reparatory process. Other organs bloodless, but no morbid condition.

CASE 7. Thomas M'Laughlan, age 22, 88th Regiment, wounded at the assault of the Redan, on the 8th September.

Ball entered anteriorly between the eighth and ninth right ribs. Exit between the ninth and tenth right ribs, two inches from spine. No fracture. Pulse 88, labouring; respirations natural. On the 12th, moist crepitation over right side. Ordered two grains of calomel and half a grain of opium, every three hours. On the 14th, the gums being tender, calomel and opium intermitted. Pulse 100; respirations 36; slight emphysema around the anterior wound. Ordered antimony every third hour. Air gurgles through anterior wound. A copious sero-sanguineous discharge flows from posterior wound.

18th. Pulse 84; very feeble. Ordered wine and brandy.

19th. Copious discharge from both wounds.

Upon uncovering the anterior wound, he appears actually to breathe through the aperture, the ordinary tracheal respiration nearly ceasing.

20th. Notwithstanding a remonstrance, he talks a great deal, and eats and drinks heartily. A most fœtid gas was largely evolved from the wounds.

21st. Dead. *Post mortem* examination. A pint of bloody serum in right pleuritic cavity. Lung forced upwards, but not backwards, and barely occupying one half of the cavity, and adherent in this position to the parietes by universal pleuritic adhesions; the false membrane, being three lines in thickness, and of ashy-grey colour. A small wound was observed on the front of lower lobe of right lung, but did not enter the substance of the organ. Around this injured part, the lung substance was dense in structure, and of a deep red colour. The other portions of the lung were filled with a red-currant jelly looking fluid. Pleuritic adhesions in left pleural cavity. Left lung engorged with the same sort of fluid as right. Liver healthy in structure, but enlarged. Right kidney contained two small cells filled with pus. Papillæ very much enlarged.

Case 11. J. McGeniss, age 25, 18th regiment, wounded on the 18th of June. Ball entered at, and fractured to the extent of four inches, the ninth right rib, near to ensiform cartilage. Exit at the angle of the eighth rib.

20th. Has been bled five times, and sixty ounces of blood abstracted: and has had calomel and antimony administered. Pulse 72; very feeble.

28th. The gums tender, calomel intermitted. Pulse 100; respirations 32.

1st July. Has become feverish, with symptoms of bronchitis.

3rd July. Air tubes engorged, and coma super-

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vening. An emetic given, with great relief to the dyspnœa.

5th July. Again urgent dyspnœa. Air passes inwards on inspiration, and outwards on expiration, by posterior wound. Died at 3 p.m.

Post mortem examination, sixteen hours after death. Twelve ounces of bloody serum in right pleura. The pleura pulmonalis coated with recent lymph; a series of radiating white lines, commencing at the apex of right lung, and terminating at the lower lobe; and upon this portion of the pleura, a number of spots, varying from a quarter to an inch in diameter, were seen, some isolated, others in groups. They could not be scraped off. Lung not wounded, but condensed to half its normal size, and bound to the spine by recent adhesions. Numerous fragments of rib lay in the track of the wound, and upon a careful examination, it was concluded that the ball had not entered the pleural cavity. No wound of diaphragm. On the surface of the liver there was a distinct bruise, as if the ball had somehow impinged upon it. Out of four cases in which the lungs were not wounded, two had dyspnœa, viz., No. 11, page 49, No. 12, page 24, a larger proportion than when the lungs were actually wounded. In twelve cases of recovery, two had dyspnœa, viz. Nos. 25 and 30. In all the cases in which it did occur, except No. 4, it was not an early symptom, and, therefore, not available as a means of diagnosis; as for instance, in the following case.

Case 18. J. Whitehart, age 21, 97th regiment. Wounded on the 8th of September. Ball entered midway between the nipple and the axilla of right side. Exit below the scapula of the same side. Great exhaustion; pulse 120; feeble, slight hæmoptysis. Continued easy until the morning of the 16th, when sudden orthopnea occurred; respirations 40 per minute; pulse 116; feeble, and he expired. No *post mortem.* Dyspnœa was present in four of the twelve fatal cases, and in one of the nine recovery cases given in the Director General's Report. In not one of the dogs experimented upon did dyspnœa supervene.

TABULAR STATEMENT OF SYMPTOMS, IN THIRTY CASES OF LUNG WOUND;

WITH THE DAYS ON WHICH THEY OCCURRED.

Reference Number.	External Wound.	Dyspnœa.	Hæmoptysis.	Emphysema.	Pneumonia.	Passage of Air.	Treatment.	Death.	Post Mortem.
Case 1	An opening on each side.	—	—	—	—	—	Calomel and antimony.	3rd day	Both cavities opened; one lung wounded.
„ 2	An opening on each side.	—	—	—	—	Outwards on expiration.	Venesection, calomel & antimony.	24th day	Lung wounded; uncollapsed.
„ 3	One opening on left side.	—	—	—	—	—	—	3rd day	Lung wounded.
„ 4	One opening.	1st day	—	2nd day	—	—	Venesection, calomel and opium.	2nd day	Lung wounded; uncollapsed.
„ 5	Two openings on left side.	6th day	3rd day	3rd day	—	—	Antimony.	8th day	Lung wounded.
„ 6	Two openings in right side.	—	—	—	—	—	Venesection, antimony and opium.	15th day	Lung wounded.
„ 7	Two openings in right side.	8th day	—	7th day	—	9th day; outwards on expiration.	Calomel, opium, and antimony.	13th day	Lung wounded.
„ 8	An opening on each side.	—	—	—	—	—	—	1st day	Lung wounded.

„ 9	One opening on left side.	—	—	—	—	—	—	1st day	Lung wounded.
„ 10	One opening on left side.	—	—	—	—	—	—	3rd day	Lung not wounded.
„ 11	An opening on each side.	12th day	—	—	—	17th day; outw. on expiration.	Venesection, calomel & antimony.	17th day	Lung not wounded.
„ 12	Two openings in left side.	4th day	1st day	—	3rd day	7th day; outward on expiration.	Calomel & opium.	8th day	Lung not wounded; not collapsed.
„ 13	Two openings in left side.	—	—	32d day	—	—	Calomel & opium.	32d day	Lung not wounded; intercostal artery wounded.
„ 14	An opening on each side.	—	1st day	—	—	24th day; outw. on expiration.	Venesection, calomel & antimony.	26th day	Opening of pericardium; pleural cavities unopened.
„ 15	Concussion.	—	—	—	—	—	—	8th day	Lung wounded; uncollapsed.
„ 16	Anterior mediastinum opened.	—	—	—	—	Outwards on expiration	—	18th day	Anterior mediastinum opened; lung, pericardium, pleural cavities, not wounded.
„ 17	Two openings in right side.	—	1st day	—	—	—	—	4th day	None.
„ 18	Two openings in right side.	7th day	1st day	—	—	—	—	8th day	None.

Tabular Statement of Symptoms, continued.

Reference Number.	External Wound.	Dyspnœa.	Hæmoptysis.	Emphysema.	Pneumonia.	Passage of Air.	Treatment.	Recovery.
Case 19	Two openings in right side.	—	—	—	—	—	Calomel and antimony.	On 37th day.
„ 20	Two openings in right side.	—	—	—	4th day	—	Salines and counter irritation.	On 36th day.
„ 21	Two openings in right side.	—	—	—	20th day	—	Stimulants.	Sent to England, on 39th day.
„ 22	Two openings in left side.	—	—	—	—	—	Stimulants.	On 16th day.
„ 23	Two openings in right side.	—	—	—	—	—	—	On 6th day.
„ 24	One opening in right side.	—	1st day	—	—	—	Salines and mercury.	On 53rd day.
„ 25	An opening in each side.	5th day	1st day	—	—	—	Tonics.	Sent to Castle Hospital, on 28th day.
„ 26	One opening in left side.	—	—	—	—	—	Antimony.	On 8th day.
„ 27	Two openings in left side.	—	—	—	—	—	Tonics.	On 12th day.
„ 28	Two openings in right side.	—	—	—	—	—	—	Sent to Castle Hospital, on 28th day.
„ 29	One opening in right side; ball apparently lodged.	—	—	—	—	—	Tonics.	Sent to Castle Hospital, on 35th day.
„ 30	Shot through sternum.	5th day	1st day	1st day	—	Outwards on expiration; 1st day.	Calomel and antimony.	On 32nd day.

TABLE OF TWELVE FATAL CASES, TAKEN FROM THE DIRECTOR-GENERAL'S REPORT.

External Wound.	Dyspnœa.	Hæmoptysis.	Emphysema.	Pneumonia.	Passage of Air.	Treatment.	Death.	Post Mortem.
No opening.	—	—	—	Present.	—	Calomel and opium.	26th day	Lung not wounded.
One opening.	Present.	—	—	Do.	—	—	6th day	Do. do.
Contusion.	—	—	—	Do.	—	Calomel and opium.	18th day	Do. do.
One opening.	Present.	—	—	Do.	—	Do. do.	14th day	Do. do.
Do. do.	Do.	—	—	—	—	Venesection.	2nd day	Do. do.
Two openings.	—	—	—	Present.	—	—	1st day	Do. do.
Do. do.	—	—	—	Do.	—	Calomel and antimony.	9th day	Do. do.
Do. do.	—	—	—	—	Present.	Calomel and opium.	53rd day	Do. do.
One opening.	Present.	—	—	Present.	—	—	—	Lung wounded.
Do. do.	—	—	—	—	—	—	—	Do. do.
Two openings.	—	—	—	—	—	—	2nd day	Do. do.
Do. do.	—	—	—	—	Present.	—	31st day	Do. do.

TABLE OF NINE CASES OF RECOVERY, TAKEN FROM THE DIRECTOR-GENERAL'S REPORT.

External Wound.	Dyspnœa.	Hæmoptysis.	Emphysema.	Pneumonia.	Passage of Air.	Treatment.	Recovery.
Contusion, opening into anterior mediastinum.	—	—	—	—	—	Tonics and good diet.	
Laceration at epigastrium.	—	—	—	—	—	Antimony; then tonics.	
One opening.	—	—	Present.	—	—	V. S.	
Contusion.	—	Present.	—	Present.	—	—	
Two openings.	—	Do.	—	Do.	—	Opium.	
Do. do.	Present.	Do.	—	—	—	Antimony.	
Do. do.	—	—	Present.	—	Present.	Opium.	
Do. do.	—	—	—	Present.	—	Antimony.	
Do. do.	—	Present.	—	—	—	Calomel and opium.	

CHAPTER VII.

ON HÆMOPTYSIS,
AS A SIGN OF LUNG WOUND.

Schmücker, at page 20, considers "hæmoptysis as proof of wound of the substance of the lung." So also do Stromeyer, Schwartz, and others. John Bell says, at page 281,—"If the patient spits blood I fear a wound of the lung; if he has an emphysema I am sure of it."

Guthrie is quite of opinion that hæmoptysis is proof of lung wound. See case of General Cole, page 467, and others at pages 474 and 475. At page 453 he relates as follows:—"A soldier of the 9th regiment was wounded at Roliga, in 1808, by the point of a sword in the left side; it penetrated the chest, making a wound somewhat more than an inch long, through which air passed readily, accompanied by a very little frothy blood, which was also spit upon any effort being made to cough, leaving no doubt of the lung having been injured, that viscus appearing to be retained against the wall of the chest." A. F. Hecker, at page 793, considers spitting of blood as the sign of lung wound. A case, H. Ashton, is given at page 63 of the Director-General's *Report*, wherein hæmoptysis took place, "rendering it highly probable that the lung had been injured"; and at page 70 a similar case is mentioned. The fact of the former having recovered, and having been sent to England in 1854, raises doubts in my mind. He was not at Chatham in 1858. Where was he? Either dead; or perhaps recovered, and joined his regiment. In the former case there was no recovery; in the latter case the lung had not been wounded. At page 67, two cases are given where no hæmoptysis occurred, and the lungs were badly wounded.

In a case recorded in the *Lancet* of the 16th of January, 1830, Mr. Lawrance says:—"Two circumstances which, viewed in combination, showed that the lung had suffered direct injury, viz., hæmoptysis and emphysema." Also, Dr. John Thomson, in his observations, at page 80, says, "That the lungs having been wounded may be inferred with certainty in every case in which a person spits blood immediately or soon after receiving a wound of the chest." Several of the appended cases contradict Samuel Cooper's statements that "at all events, when no blood is spit or coughed up, the lungs can never be deeply penetrated." In the *Lancet* of the 21st June, 1856, page 682, Mr. Binnie, writing from the Crimea, shows that lung wound was diagn [illegible] "hæmoptysis"; also, in the same number of the *Lancet*, Mr. Hancock mentions several cases of recovery: but he takes his proof of lung wound "evidenced by expectoration of blood."

Similar opinions prevail in the works of most writers, Dr. Ballingall, for instance, at page 308; and in almost all recorded cases of alleged lung wound "hæmoptysis" is taken as the certain pathognomonic proof. As an illustration of this state of opinion, attention may be drawn to a remarkable case, of which there is a preparation recently put up in the College of Surgeons' Museum.

"Henry Barrott, age 27, 1st Life Guards, was wounded on the 18th of June, 1815, at the battle of Waterloo. The ball passed through the muscle of left humerus, fractured two ribs, and entered left thorax; no wound of exit. He lived forty-two years and a hundred and seventeen days after the receipt of the wound. At the *post mortem* the left lung was found completely solidified and firmly bound to the spine. Mr. Leash goes on to say:—"On separating the adhesions, a large abscess in the lung was opened, which contained about a pint of fœtid pus. In detaching the lung from the posterior wall a cyst was accidentally opened, which contained the ball, which escaped for the moment into the cavity of the chest."

Mr. Leash observes:—"My own impression is, that the ball having entered the chest, and being nt, instead of passing at once into the substance of the lung, glided down posteriorly between the lung and ribs, and slightly wounding the lung, became fixed." . . "That the lung was wounded, the hæmoptysis proves; and that violent inflammation followed, the bleedings spoken of go far to prove." I ask, where is the proof that the lung was wounded ? A cyst would seem to have been formed around the ball between the pleura-pulmonalis and costalis, and consequently external to the lung. The presence of the abscess, unless the ball had been found within its walls, which it was not, is no proof of an actual wound of the lung.

When hæmorrhage does occur to such an extent, as to threaten suffocation, it becomes a hæmorrhage from the mouth, and indicates a wound of a large blood vessel, with wound of the trachea, or some large bronchial tube.

A case, illustrative of the above remark, is given in volume vii, page 315, of the *Transactions of the Medico-Chirurgical Society*, of stab wound of the trachea. Great hæmoptysis occurred. This is what should be expected.

A preparation may be seen in St. George's Hospital Museum, in which there is a laceration, about four inches in length and two in depth, and gaping one inch, of the right lung. There was no hæmoptysis; but if ever it is to happen it should have occurred in this instance. The patient died on the eighth day. The lung was found much congested, but no hepatisation or other sign of pneumonia.

In the *Lancet* of 21st June, 1856, page 682, a case is mentioned in which there was hæmoptysis. Sixty-eight ounces of blood were drawn, and he recovered. There is no proof that the lung was wounded. The following case will illustrate the doubtful value of hæmoptysis as a means of diagnosis:—A. Door, age 23, 23rd regiment, was struck by a ball on the 8th of September, which passed through the right pectoral muscle. Copious hæmoptysis occurred during the first twenty-four hours. Rest and low diet were enjoined, with salines. A rapid recovery took place. There is no doubt that the lung was not wounded, because the man during convalescence, and for the remainder of the war, became servant to the author, and never showed any further symptom of lung wound. This was a case of concussion. Baudens, in his *Clinique*, page 222, and the Director-General's *Report*, page 62, case of sergeant B. Lodge, refer to similar cases. In Galen's time, spitting of blood was known to occur in chest wounds, and the lung not wounded. My Crimean colleague, Dr. McLeod, still reiterates the ancient dogma, at page 236 of his *Notes on the Surgery of the War in the Crimea*, when he says, "blood by the mouth, and blood and air by the wound, are unequivocal proofs that the lungs have been injured": also Stromeyer, at page 600, says that hæmoptysis is never absent.

Among the cases observed by me, at the same period that Dr. McLeod was engaged making his *Notes*, out of nine fatal cases, in which the lungs were wounded, only one had hæmoptysis (Case 5, page 47, and Case 24, as below). Out of seven fatal cases, in which the lungs were not wounded, two had hæmoptysis. Out of twelve cases of recovery, three had hæmoptysis. In none of the dogs experimented upon did hæmoptysis appear. It is therefore inferred that "spitting of blood" may be a very deceptive diagnostic sign of lung wound.

Case 24. James Whitmill, aged 21, 96th regiment, wounded on the 8th September. Ball entered between the second and third right ribs, and appeared to have lodged; no fracture of ribs. There was considerable hæmoptysis, and great depression. Ordered beef-tea, and absolute rest.

10th Sept. Hæmoptysis ceased.

12th. Increased resonance of voice on right side; no crepitation, or dulness on percussion. Pulse 116; respiration 28. A saline mixture three times a day.

6th Oct. Complains of pain in right side. Ordered the twelfth of a grain of the bichloride of mercury three times a day; and a blister to be applied to the right side.

31st. Respiratory murmur distinct on both sides. Still a slight dulness on percussion of right side, a subclavicular depression, and incurvature of spine towards right side.

This day, upon learning that he was not to be invalided home, he left the hospital without permission, and joined his regiment [illegible] to his comrades that he was [illegible] well.

CHAPTER VIII.

ON EMPHYSEMA,

AS A SIGN OF LUNG WOUND.

The term "emphysema" has been applied to two very different conditions; one is most frequently the result of disease, and is a preternatural inflation of an indefinite number of the lung air-cells, with or without coalescence or rupture. The air permeates beneath the pleuro-pulmonalis, causing bullæ on the margin of the lungs. These bullæ may be ruptured, and the air, during inspiration, will pass, in varying quantity, through the orifice or orifices, into the pleural cavity; and, as it cannot return through the lung, it will accumulate more and more at each inspiration, and ultimately counterbalance the dilating power, and the lung will collapse.

This condition may occur in warfare, from rupture of the lung by a concussion, and there may be no injury to the walls of the chest. Although the term "emphysema" may be correctly applied to this condition of the lung, it is incorrect to apply it to the state of the pleural cavity: pneumato-thorax is the term which should be employed, in contradistinction to the second condition, " traumatic emphysema".

This may follow :—

1. A penetrating wound of the chest; lung uninjured.

2. A penetrating wound of the chest; lung injured.

3. These may or may not be complicated with fracture of a rib or ribs.

In the Director-General's *Report*, page 63, case J. O'Niel, we have an illustration of the faith still placed upon this sign. " The wound was soon followed by emphysema . . . . showed unmistakeably that the lung had been injured."

Emphysema is put down by some writers as a most certain sign of lung wound. For example, La Motte (*loc. cit.*, page 35); Ferrien (*Elemens de Chirurgie*).

In the *Lancet* of 14th February, 1852, emphysema is considered as a certain sign that the wound had penetrated the lung. A case of recovery is noted in the *Medical Times* of 17th December, 1853 (page 638), and the proof given of lung wound, is " emphysema and dyspnœa"; also, in the same Journal of 6th April, 1841, page 21, a case of recovery from a stab is related, and the proof of lung wound is " emphysema": again, in the same Journal of 27th April, 1850, page 336, a case is reported as under the care of my colleague, Mr. Adams, in which an iron rail-spike passed into the right side of the chest from three to four inches: considerable emphysema was present, but no other symptom of lung wound. Mr. Adams specially observed, that there was no inflammatory action, and that no depletion was required. Recovery took place speedily.

In the three foregone cases, I am sceptical as to whether the lung was wounded: they were most probably similar to the following case, which was mentioned to me by Mr. Holmes, of St. George's Hospital; in which the simple presence of emphysema was considered sufficient to determine the diagnosis as to lung wound. A spike passed through the scapula, into the chest; the lung, nevertheless, was found untouched. In the Director-General's *Report*, page 63, emphysema is given as proof of lung wound.

The two following cases are given, however, as instances of emphysema where the lung was *wounded.* The preparation is in the museum of St. George's Hospital. "A pistol bullet passed through the upper surface of the left lung. The pulse was 104, sharp and weak, and soon rose to 166. The patient was bled to thirty-three ounces. The pulse became more rapid; and the other symptoms were not relieved. He died in two days." A preparation of the other case is in the museum of Guy's Hosp [illegible] man fell from the mast of a ship, a height of sixty feet, and a belaying pin entered the chest, between the third and fourth ribs of left side, and passed through the lower lobe of the lung. He died in twenty-four hours. The lung was found collapsed; and fluid in the pleural cavity. A portion of cloth had been carried in with the belaying pin, and was found in the lung, and seemed to have formed a plug." The following remark is added: "though the wound was not one that would bleed freely."

The following case, in Guy's Hospital *Reports*, vol. iii, second series, shews very clearly that emphysema, taken by itself, is not a certain sign of lung wound, but that it may arise in the absence of those conditions which are considered necessary for its presence, viz. injury to the ribs, or walls of the chest. There was a "contused wound on the right side, opposite the eighth rib, from a fall on a spike; no fracture; emphysema of the whole side of the chest. No other symptom whatever." There was probably laceration of the intercostal muscles.

Emphysema occurred in only four of my eighteen fatal cases; in three out of the four, the lungs were wounded. It occurred in one out of twelve of my cases of recovery. In the Director-General's *Report*, it occurred in two out of the nine cases of recovery: it is not mentioned in any one of the twelve fatal cases. It did not occur in any one of the dogs experimented upon.

Knowing that Baron Larrey had stated in his

Clinique Chirurgicale (page 188) "La plupart des plaies pénétrantes de la poitrine, sont suivies d'un emphysème plus ou moins considérable", I could not explain how this remark had proceeded from so acute an observer, until, upon looking over his cases, I found that the six in which emphysema occurred were stab wounds. Mayer also, at page 28, had previously observed its greater frequency in stab wounds. John Bell, also, made the same observation. The Baron inculcates, and in all the cases pursued, this proceeding. To render the external parallel to the internal opening, by dividing the skin and submuscular substance to the extent that each case required; thereby to give a free exit to the effused air. An explanation is hereby afforded of the cause of the rarity of emphysema in gun-shot wounds, as distinguished from stab wounds, of the chest. Stromeyer, at page 602, gives another explanation for the rarity of emphysema: "A ball passing into the substance of the lung bruises it, and causes an immediate extravasation of blood in the lung substance; so that no air can pass from the air-vesicles, or small tubes, into the pleural cavity." Baudens, at pages 230 and 259, gives a similar explanation.

Pleuritic adhesions at the external opening will also prevent emphysema, as noticed by me at several of the *post mortem* examinations. This cause is also alluded to by Hewson. He writes "of the wound in the lung being surrounded by wound, there being no lymphy matter. After a considerable number of experimental, as well as practical observations, it may be affirmed that in cases where an opening exists in the chest wall, the ordinary signs indicative of pneumonia are so modified that little reliance is to be placed upon them. The fact is, that the lung does not play, and the ordinary respiratory murmur is not produced, although there may be a certain amount of inflation. This partial inflation occurred in Experiment 2, page 29, and also in Experiment 6, as related by Dr. Houston, in vol. xix of *Philosophical Transactions*, page 138; it also occurs in cases of true pneumonia, in which, after an apparent perfect recovery, there still remains much dulness on percussion, and an absence of, or at the most a very obscure, respiratory murmur, although it is certain that the lung is working. This fact I have not seen stated in any work on auscultation. The vesicular structure in such cases may have undergone a certain change, impairing its elasticity, and weakening its sound-producing power. Here arises the very important question, but which must be merely glanced at, What is the difference between "traumatic" and "idiopathic" pneumonia? In the latter there is the exudation and deposit of "plastic" lymph; in the former this is never observed. The appearance revealed at the *post mortem* examination would by many persons be attributed to the effects of inflammation, whereas it is only an excessive congestion, as seen in Experiment 10. Indeed, by reasoning the conclusion will follow, that the conditions are dissimilar: one is the effect of a mechanical injury; the other, of a constitutional disturbance, or, in the language of the day, "a blood disease." The effects of traumatic pneumonia are of a congestive nature, generally localized, and not followed by the characteristic exudation of a true inflammatory process, and its frequent sequel, the formation of pus. On the other hand, idiopathic pneumonia is known by its characteristic exudations, the formation of pus, and its spreading tendency.

In the small number of cases of traumatic pneumonia, in which pus becomes formed, it may generally be traced to the prolonged detention of a foreign body, therefore causing to the afflicted patient a tedious abscess. Abscesses from this cause sometimes create very anomalous symptoms, namely, the occurrence of a copious, vicarious expectoration which, for the time being, alarms equally patient and doctor. The expectoration, after a day or two, disappears, and may continue to reappear and disappear at irregular intervals for a long period. John Gooch, in vol. ii, page 145, explains the long duration of such cases. "At the autopsy it was shown that a very large abscess emptied itself, syphon-like, when the purulent matter reached to a certain level in the sac."

Experiment 10. A Minié bullet was shot through the chest-wall of a large healthy dog. The bullet entered at the fourth right rib, two inches from the sternum, and passed out at the third left rib, half an inch from the sternum. Instant death took place. Upon examination, it was found that the ball had passed through the inferior and anterior margin of the upper lobe of the right lung, but so near the margin as to have left a delicate bridle across the wound; then struck the anterior surface of the heart, forming an irregular jagged wound, one-third of an inch in diameter, directly over the infundibulum, and half an inch below the pulmonary semi-lunar valves. The pericardium, as also the right pleural cavity, was filled with coagulated blood, even in the short period, having completely encased the lung. The two lungs, save at one part, were completely and remarkably blanched, so much so that, upon cutting into them, not a single drop of blood oozed out. This blanched state brought out in strong relief the following striking appearance. The portion of the lung close to the wound, two inches in length and one inch in breadth, was of the most brilliant vermilion-colour, apparently caused by intense congestion. The blanched state of the lungs arose, no doubt, from a cessation of the pulmonary circuit. The marked congestion might have deceived any one into the belief that strong inflammatory action had taken place, but which was impossible in the circumstances: it was the product of numerous ruptured capillary vessels.

To continue the subject. In the case of shot-wounds, according to Professor Schuh (*Wiener Wochenschrift*, 1857, No. 2), one of the elements necessary to induce pneumonia is absent, viz., the rough and sudden inflation of air into the delicate lung structure, as a wounded lung is partially, if not altogether, undilatable. When the lung of the injured side is collapsed, whether wounded or not, it is evident that additional work is thrown upon the lung of the uninjured side. If this be a correct interpretation of facts, pneumonia is not to be dreaded in the lung of the wounded side; on the contrary, it is more likely, from the excessive and increased work, to attack the overtasked sound lung. Pathology does not show, however, that this is the case. The microscopist may be enabled to detect a pathological difference; and the practical deduction will be, that the treatment must be adapted to the varying etiological and pathological conditions.

In the *Medical Times* of the 23rd of November, 1850, there are some pertinent remarks on this subject by Mr. Henry Smith. A case mentioned by Dr. Macleod, at page 234, would appear to militate against the opinion I have expressed; where "the whole contents of the thorax were found implicated in one vast inflammation;" but the Doctor admits that he was not present at the *post mortem* examination, and consequently the statement is valueless to a certain extent, as the true inflammatory exudation may have been absent.

A case is mentioned by John Gooch. A boy fell from a considerable height upon a plough coulter. The left thorax was opened, and the lungs, diaphragm, and heart were seen in motion. He survived nine days. No pneumonia or pleuritis supervened. Baudens (at page 234 of his *Clinique*) says that pneumonia is a rare consequence of a simple wound of the lungs. The result of Experiment 10, page 71, and the following cases, are highly illustrative of the deceptive appearances presented by congestion. I have not the slightest doubt but that similar appearances have frequently been reported as the effect of true inflammatory action.

CASE 13. D. Hourigan, aged 29, 88th regiment, wounded on the 8th of September. Ball entered two inches above left nipple; fractured the fifth, sixth, and seventh ribs; cut out near the angle of eighth rib. Another ball entered right popliteal space; cut out over inner condyle of femur. Pulse 70, feeble; respirations 25. Ordered wine and beef-tea.

12th. Pulse 88; respirations 48. Ordered calomel and opium.

Remained much the same until the morning of the 24th, when a copious bronchial secretion began to be formed, and caused considerable dyspnœa. Very low, and refused nourishment.

25th. Plentifully supplied with wine and nourishment during the night. Rallied, and dyspnœa relieved.

Continued to vary from day to day, the case-book showing that on one day the pulse rose to 120, and the number of respirations to 32; and, upon another day, the pulse fell to 76, and the number of respirations to 28. According to symptoms, he was ordered stimulants, calomel, and opium.

On the 10th of October, having had previously no new adverse symptom, sudden hæmorrhage took place from the posterior wound. This was controlled by pressure on the intercostal of the eighth rib; nevertheless, he died exhausted at 5 P.M.

Examination, twelve hours after death. A powerful pleuritic adhesion around the fractured portions of the fifth, sixth, and seventh ribs; thereby completely isolating the fractured parts from the main pleural cavity. The lung found unwounded, and in its normal situation; it was congested, very friable, and some portions of it sank in water, and did not regain buoyancy on strong pressure. Other organs healthy.

The congestion noticed in the following case would also be put down, by many persons, as the effect of inflammatory action.

CASE 6. William Bates, aged 22, 41st regiment, wounded at the assault of the Redan, on the 8th of September. Ball entered between the base of the right scapula and spine, opposite the fourth costal vertebra; exit, anteriorly, on the right side, close to the sterno-cleido-mastoideus muscle. Pulse 92; respirations 25. Ordered beef-tea, and absolute rest.

On the 12th, pulse rose to 100, and respirations to 40. No abnormal sounds on auscultation. Ordered small doses of the tartrate of antimony frequently during the day, and a dose of morphine at night.

There being no improvement, on the 16th he was bled to sixteen ounces. Blood cupped, and a very large proportion of serum.

17th. Pulse 100; respirations 28.

On the 19th, large coagula of blood escaped freely from posterior wound. This discharge continued to flow copiously; and he gradually sank on the 23rd of September.

In this case death was accelerated by his indulgence in fits of great excitement and wayward passion.

Examination. The posterior wound, two inches in diameter. Fourth right rib, and corresponding vertebra, fractured. The apex of right lung merely skirted by the ball, which had caused a fissure in, and not a passage through, the lung. The substance of the lung near the wound congested. No sign of pleuritis. It is curious to conjecture the relative position of the two opponents, seeing the unusual course of the ball.

In not one of the nine fatal cases, in which the lungs *were* wounded, did pneumonia supervene. Out of nine fatal cases, in which the lungs were *not* wounded, it appeared in one case. Out of twelve cases of reco [illegible] appea [illegible] two. In

CHAPTER X.

ON PLEURITIS,

AS A SIGN OF LUNG WOUND.

INFLAMMATION of the pleura has not been sufficiently noticed as one of the effects of "penetrating wounds of the chest." I believe that an inflammatory action in the pleural membrane is sometimes the effect of stab or bullet wounds in the chest, but not a usual consequence. I have been unable to discriminate between traumatic and idiopathic pleuritis; and consequently when, in cases of chest wound, a lymphy deposit is observed after death in the pleural cavity, the conclusion has been that ordinary inflammatory action has been at work.

The appearance described in Experiment 5, page 32, as if some of the pleuritic adhesions were partially plugging the wound, has been observed in the human subject: see Thomson's *Observations in the Military Hospitals in Belgium*, page 91. John Hunter had an idea that this was the natural process of cure, as deduced from the result of experiments performed on animals. If this theory be recognised, then the process is not to be considered as at all the same as idiopathic pleurisy. The very frequent instances discovered at the *post mortem* examinations, of large sero-sanguineous effusions into the thoracic cavities, fully bear out this opinion. Indeed, these effusions seem very constantly to be the proximate cause of death. The following cases support this view.

Case 1. John Maher, aged 25, 57th regiment, was wounded at the unsuccessful attack on the Redan on the 18th of June. Ball passed through both lungs. Died on the 21st of June.

Examination. Pleura pulmonalis and costalis in both cavities glued together by lymph, but easily separable. Substance of lungs much congested.

Case 3. A. B., wounded on the 18th June. Ball struck below left acromial process, passed through the left pectoral muscle, and backwards under the scapula, entering the thorax at, and fracturing the sixth left rib, and passing through two inches of the lower lobe of left lung, traversing spine at the ninth vertebra, and finally lodged under the skin. Lived three days.

Examination. Left pleural cavity filled with bloody serum. Fragments of bone lying in track of wounded lung. The portions of lung surrounding track of wound consolidated; other organs remarkably healthy.

Case 8. C. D., belonging to the 4th regiment, was ed on the 8th of September. The ball fractured the ninth left rib, and wounded in its course the lower edge of the left lung, diaphragm, spleen, and liver. Exit at the eighth right rib. Dead in twelve hours.

Post mortem examination. Left pleural cavity filled with blood and serum, and a considerable quantity in abdominal cavity. Pleura-pulmonalis coated with coagulated blood, having a honeycomb appearance, easily peeled off, leaving pleura healthy.

CASE 9. G. H., of the 49th regiment, wounded on the 20th of September. Ball entered at the apex of the left thorax, fractured acromial end of clavicle, and wounded posterior margin of left lung, in the substance of which the ball was found.

Post mortem examination. Left pleural cavity half full of bloody serum. Track of wound lined with a light greenish coloured membrane, and adherent to lung substance. No consolidation of lung, the whole of which appeared to be remarkably healthy; a membraneous looking deposit invested the base of the lung, easily peeled off, leaving the subjacent pleura healthy.

CASE 10. L. M., wounded on the 18th of June. The ball entered between the acromial end of the left clavicle and the head of the humerus, passed into the thorax at, and fractured third and fourth ribs, passed downwards and made exit at, and fractured the ninth and tenth ribs, and lodged under the skin. Lived three days.

Post mortem examination. Left pleural cavity filled with bloody serum. The pleura-costalis, and pulmonalis, at wound of entrance, united by recent lymph. Lung not wounded; but its surface covered by a layer of coagulated blood, having a honeycomb appearance, easily peeled off, leaving pleura apparently healthy.

Case 32. J. Crooks, aged 31, 3rd Buffs. Wounded in the trenches on the night of the 20th of July, during a sortie by the enemy. Ball entered the right shoulder-joint, and was extracted. In a few days, erysipelas attacked the wound, and symptoms of acute pleuritis were also present. Bark, ammonia, and wine were administered; but he died on the 24th of July.

Post mortem examination. Wound of shoulder showed no sign of granulation. Upon raising the sternum, an abscess was observed in anterior mediastinum. Both pleuritic cavities filled with pus, bloody serum, and flakes of recent lymph. An abscess at apex of right lung. Portions of both lungs highly congested; and the whole of their substance infiltrated with a red currant jelly-looking fluid. Heart large and flabby; liver healthy. No pus in any other cavity, or in any of the joints.

Case 33, in the regimental hospital of the 49th regiment. A. B., wounded on the 8th September. Ball entered at upper part of left thorax, fractured acromial end of clavicle, passed through and found imbedded in the base of left lung. Died on the 20th of September.

Examination. Course of the ball lined by a greenish-coloured membrane, not easily removed. Lung substance healthy. A remarkable looking membrane (effused and partially organised blood?) clothed the lower lobe of the lung. It easily peeled off, leaving the pleura apparently healthy.

CHAPTER XI.

TROMATOPNŒA;

OR, THE PASSAGE OF AIR THROUGH THE EXTERNAL APERTURE, AS A SIGN OF LUNG WOUND.

THIS occurs often with a loud gurgling sound, and the aperture of the wound appears to supersede entirely the natural passage. The effect is most startling upon the bystanders, and is generally considered a certain sign of the substance of the lung having been wounded, and a prelude to dissolution. Hippocrates says, "the patient dies if more air passes through the wound into the thorax, than enters by the trachea into the lungs." Galen held a similar opinion. Whether these ancients formed their opinions from experiments or other sources, they had arrived at precisely the same results as Hewson, Van Swieten, and others of modern times. Dr. John Thompson, in his *Observations made in the Military Hospitals in Belgium*, page 80, observes:—"It is often difficult to say, in wounds of the chest, whether they penetrate into the sacs of the pleuræ; but all doubt with regard to this point is removed the moment we observe air coming out of the wound upon coughing." This observation having been made by a man of standing, the perpetuation of erroneous opinions will not create surprise. A. F. Hecker, a great German authority, writes in vol. ii, page 779, to the same effect. In the *Transactions of the Medico-Chirurgical Society* of October 1841, page 564, a case of recovery from lung-wound is narrated, and the proof given is, "both blood and air escaped from the wound in the chest;" also, in the same *Transactions* for October 1842, page 615, there is given a case of stab-wound through both sides; venesection was practised, and recovery took place. The proof given of lung-wound is, "air was passing freely through the wound. . . . . No doubt could exist as to the lungs being wounded on both sides." In the *Medical Times* of the 2nd November, 1850, page 469, Mr. George Shaw reports a case in which the wound penetrated the right chest between the fifth and sixth ribs. The air passed into and out of the wound with considerable noise every time he breathed. No depletion employed, and he recovered.

In the recent case of Thain the policeman, who was shot while guarding a prisoner (the preparation is in Guy's Hospital Museum), the report shows, that "blood and air passed through the wound, and there was a little hæmoptysis." He died on the second day. The lung was found not wounded."

Dr. Ballingall, in his *Outlines of Military Surgery*, page 306, says, "when air issues from a wound in expiration, there is ground for suspecting that the lungs are wounded." The following Experiment, No. 2, leads to a different conclusion. The following case, No. 30, also shows that tromatopnœa was present when there was very little probability that the lung was wounded.

Experiment 2. A dog was placed under the influence of puff-ball. An opening was made into the right pleural cavity, between the third and fourth ribs. The external air passed freely inwards upon inspiration, and outwards upon expiration. No emphysema occurred. Heart's action continued long after respiration ceased. Dr. Richardson considered that the lung did collapse in this case, although slight respiratory murmur was heard over affected side. When the dog was examined, the lungs were found unwounded.

CASE 30. J. Meskell, aged 22, 3rd Buffs, wounded on the 8th of September. Ball struck on the upper third of the sternum, passed downwards, and appeared to have lodged somewhere about the lower dorsal vertebra in the left side. Air gurgled with a loud sound through the wound on expiration. Pulse 78; respiration 30. Considerable hæmoptysis. Emphysema around the wound.

11th. Emphysema has extended over all the left side.

12th. The air has ceased to gurgle through the wound.

15th. Copious hæmoptysis; pulse 64; respiration natural. Febrile symptoms occasionally appeared, the pulse rising to 88, and the respiration to 44. The treatment was antimony, low diet, and rest.

On the 10th of October he was discharged to his regimental hospital.

I am indeed of opinion that, when the lung is really wounded, this tromatopnœa must cease; thus, when a small opening is made into the thoracic cavity without wounding the lung, air will pass freely out and in during respiration; but if the opening be enlarged, and the lung be so wounded, that there is a direct communication formed with the opened pleural cavity, the entrance and exit of air will cease, from the simple physical fact that all opposition is removed, and no confined body of air is subjected to the alternate movements of the thorax. Tromatopnœa was present in two out of twelve fatal cases, and in one out of nine cases of recovery, recorded in the Director-General's *Report*. Out of nine fatal cases, noticed by the author, in which the lungs *were* wounded, it was present in two. Out of seven fatal cases, in which the lungs were *not* wounded, it was present in one. Out of twelve cases of recovery, it was present in one. Among all the cases, strange to say, it was especially marked in Nos. 14 and 16; in the former, the pericardium was wounded; in the latter, the anterior mediastinum was opened; but in neither were the pleural cavities opened. Experiments Nos. 3, 6, 11, bear upon this point.

In concluding this portion of the treatise, I would desire to say that, although I would not place implicit reliance on any one of the heretofore accepted signs of lung-wound, if there were three or more of them present, I should consider their concurrence as strong presumptive proofs of lung-wound. To these add a weak pulse, a cold and clammy skin, and orthopnœa with effusion of blood, now easily diagnosed by aid of percussion and the stethoscope, and the presence of the ecchymosis of blood in the loins (but which I never witnessed, although it is dwelt upon as certain evidence of effusion into the pleural cavity, by Valentin and others); with all these, or the majority, it may be considered as nearly certain that the substance of the lung has been wounded, and the danger imminent. Indeed, if it were not for the distinct statement made by Baron Larry, at page 240, as to the presence of this peculiar discoloration, "ce signe est l'un des plus pathognomoniques", I should consider this as one of many matters of romance, unthinkingly handed down by one writer to another.

CHAPTER XII.

LUNG WOUNDS, AND THEIR COMPLICATIONS.

In this portion of the treatise, I shall briefly allude to the complication of lung-wounds, with

1. The Heart, and large vessels.
2. The Mediastinum.
3. The Diaphragm.
4. The Œsophagus.
5. The Trachea.
6. The Thoracic Duct.

Here would properly come observations upon wounds of the pericardium and of the heart; but as no case came under my immediate observation, I refrain from entering upon the interesting subject, observing merely, that wounds of the heart are not now considered, as in ancient times, instantly and invariably fatal; it is yet to be shown how deeply and seriously the heart will bear external injury without destruction to life, for it is certain that it will bear more injury than was formerly supposed. The following case applies to this point: it was communicated to me by Dr.

Aitkin, late Pathologist to the Army in the East, and author of the *Practice of Physic;* as also case No. 14:—

"A boy, about 14 years of age, standing near to a party of recruits being drilled in the use of firearms, on the 24th of September, 1854, had the contents accidentally of one of the rifles lodged in his chest. He was taken to the Royal Infirmary of Glasgow, near which the accident occurred, and survived three days." I give only the portion of the examination which applies to the present question:—"The pericardium was entire; but on opening into its cavity, the serous surface corresponding in position to the injured part of the lung, was somewhat red from blood-vessels ramifying over its surface. A lacerated wound extended for about half an inch in length upon the anterior and lateral surface of the left ventricle, near to, and parallel to the septum." *Museum Catalogue*, Nos. 8, 9, 10, 11.

In the examination of Experiment 10, page 71, we could not be certain whether we had detected an opening in the pericardium; but the substance of the heart being wounded, we considered it very improbable that the heart could have been wounded without the pericardium having been opened, and attributed the non-discovery to defective observation. But the report of the foregoing case shows that the heart may be ruptured and the pericardium nevertheless entire; and consequently in the foregoing experiment this singular pathologico-anatomical fact may have been present. A case of bayonet wound of the heart is related in vol. ii, page 58 of the *Medico-Chirurgical Transactions.* A curious case of wound of the heart is related in the *Medical Circular* of 27th October, 1857, page 173. The ancients knew that the wounds of the pericardium were not of themselves fatal, but from the consequent injury to surrounding parts: several of my cases illustrate this point.

I have not met with a case of wound of the aorta or cavæ in my *post mortem* examinations, nor is mention made of an instance of this kind in the Director-General's *Report.* There is no doubt that the resilient power of the arterial coats, and also the elastic nature of the coats of the large veins will, in a great measure, explain this curious exemption from injury. The case of wound of the subclavian vein, reported by Mr. Blenkins at page 13, is a solitary recorded instance. This exemption may, however, be more ideal than real. The cause of death of most, if not all, of the killed on the field of battle is probably from torn and ruptured blood-vessels.

The two following cases are given specially as "opening into the *mediastinum.*" In No. 14, other interesting pathological appearances were observed, which suggest the inquiry, whether the vomiting stated to have been present depended upon injury to the phrenic nerve? The enlarged stomach noted in this case was observed by me in several other cases. The observation made as to the distended auricle, will require future verification before a physiological datum can be drawn.

CASE 14. James Fleming, aged 22, 18th regiment, wounded on the 18th of June. Ball passed through the biceps muscle of the right arm, revolved round the bone, and entered the thorax between the third and fourth ribs. Exit one inch below left mamma fracturing sternum. Pulse 100, full; respiration 25. Hæmoptysis. Ordered a grain of calomel, half a grain of antimony, three grains of hyoscyamus, three times a day.

22nd June. No change; medicine intermitted; and bled to forty ounces.

24th. Pulse 90, with strong heart's impulse. A peculiar watery crackling sound is heard over middle of sternum at systole of heart. An opiate ordered.

27th. To have ten drops of the tincture of digitalis three times a day.

6th July. The digitalis seemed to have no power over the action of the heart, which varied in its pulsations from 94 to 104; respirations from 28 to 44. To-day, has pain in right side; friction sound audible three inches below left nipple. A blister applied; and a pill of two grains of calomel, and a quarter of a grain of opium ordered every three hours.

7th. Pulse 92; respirations 28. An incision made over centre of sternum, and several loose portions of bone removed. Pill intermitted. A large artery can be felt pulsating upon introducing the little finger into the wound.

11th. More portions of bone removed.

12th. Pus and serum seen at the bottom of the wound. This fluid is drawn *inwards* on inspiration and forced *outwards* on expiration.

13th. Frequent vomiting and diarrhœa. Nutritious injections ordered.

14th. Incessant vomiting. A circular opening in pericardium, a quarter of an inch in diameter, seen at the bottom of the wound, and from which proceeds a whiff of air on expiration. Died at 11 A.M.

Examination two hours after death. A quantity of burrowed pus escaped upon making an incision across the wound in the sternum; at this spot the bone denuded of periosteum. The cartilages of the second, third, and fourth ribs, and corresponding portions of sternum, carried away. The posterior wall of the anterior mediastinum coated with a greenish coloured lymph. An opening existed, five lines in diameter, into the pericardial cavity, just over the right auricle. This opening led into a small chamber of limited extent, formed by pericardial adhesions. The finger could, however, be passed into the general pericardial cavity, showing that a complete sac had not been formed. Two ounces of pus in pericardium, and both pericardial surfaces coated with lymph. Endocardial membrane healthy; neither pleural cavity opened by wound. The stomach much enlarged, the great curvature falling down, in the form of an acute ellipsis, considerably below the umbilicus; its mucous coat blanched and very soft, and easily scraped off. It was distended by a quantity of a greenish coloured fluid. The mesenteric glands, also the solitary glands of colon much enlarged; the mucous membrane of colon highly congested, and Peyer's patches very visible. From examination during life, it appeared to me as if the right auricle of the heart had no systole or diastole, but was constantly in a state of distension.

Case 16. William Smith, aged 25, 49th regiment, wounded on the 8th of September. The ball struck the upper bone of the sternum, and was cut out from the right axilla. Pulse 60, soft; respirations 25.

12th. Pulse 104. The external wound is two inches in diameter, and exposes the anterior mediastinum. Several loose portions of the sternum having been removed, the pericardium was distinctly seen. Considerable secretion of pus, which flows out freely on the patient turning on his stomach.

26th. Unaltered since last report. To-day the formation of pus is much diminished. A portion of the inner table of the sternum seen lying at the bottom of the wound, and cannot be removed by moderate force. Pulse 100; respirations 30. During inspiration, the sternal opening contracts and the pericardium recedes from the parietes. In the afternoon, hæmorrhage to the extent of a pint from the wound. He could not be rallied, and died at 10 P.M.

Examination. The upper third of sternum separated from the two lower thirds, and the inner table driven inwards. The cartilages of both second ribs severed from the sternum. The intercostal muscle between the second and third ribs carried away to the extent of two inches. Pericardium, pleuritic cavities, and substance of lung, uninjured. No source of bleeding discovered.

WOUNDS OF THE DIAPHRAGM.—Mr. Guthrie and M. Baudens would, in their writings, lead to the conclusion that they, as moderns, had made the notable discovery that wounds of the diaphragm are mortal; but Hippocrates, *Aphor.* 18, Galen, in *Commentary* 6, and Celsus, book 5, chap. 16, have anticipated both of these gentlemen: even John Tagaultii, at page 52, says, "Vulnera quoque diaphragmatis prorsus incurabilia sunt, maxime si in partis ejus nervosa fiant." To M. Baudens, I have found (*Clinique*, page 303), belongs the credit of having suggested the plan, to open the abdomen and relieve the strictured intestine in the event of a diaphragmatic hernia; he also proposed to introduce a portion of the omentum into the wound to act as a plug, and, by the adhesions which would be formed, prevent future hernia. A fatal case of wound of the diaphragm and lung will be found in the *Lancet* of 19th January, 1856. The report made by me, and sent by Mr. Guthrie for publication, I consider is of sufficient importance to reprint it, as it appears that only two others were noticed during the war.

"M. O'G——, aged 18, private in the 30th regiment, was struck by a Minié bullet while in the act of retiring into the trenches after the failure of the attack on the Redan on the 8th September. The bullet entered midway between the angle of the ninth rib and spine, and made its exit one inch outwards from the left nipple. On his arrival at the hospital, a few hours only after the infliction of the wound, he laboured under considerable dyspnœa, had hæmoptysis, and some emphysema was present around the posterior wound, through which air and frothy fluid freely passed during respiration. The pulse was 70, feeble and irregular; skin cold and clammy. Ordered warm tea and a little wine.

"Sept. 9th. The dyspnœa was greatly relieved.

"10th. The pulse rose to 80, still feeble and very irregular; number of inspirations 28.

"12th. Pulse 100, very feeble; emphysema continues; no hæmoptysis; no morbid murmur heard in the lung. Low diet strictly enjoined.

"13th and 14th. The patient is very easy and composed.

"15th. Early this morning he was seized with severe vomiting whenever anything was swallowed.

I found him pulseless; number of respirations 40 per minute; countenance haggard and anxious; enormous aqua-sanguineous discharge was going on from the posterior wound. The thirst was now excessive, and his plaintive moanings at not having as much cold water as he desired were very painful to hear. He drank a large quantity of water a few minutes before death, and expired at 10 P.M.

"*Post mortem* examination. On opening the thorax, and pursuing the investigation from the wound of entrance, the ninth left rib was found fractured; the bullet must then have grazed and injured more or less of the muscular portion of the diaphragm, then passed through the base of the lower lobe of the left lung, making its exit at and fracturing the fourth left rib. The lung was pressed upwards (but not backwards, as in cases of effusion), and occupied only half the cavity; recent adhesions existed between the two lobes, also between the pleuro-pulmonalis and costalis. Half a pint of bloody fluid lay in the posterior part of the cavity. Around the track of the wound in the substance of the lung there was considerable congestion, which gradually shaded off into healthy structure. No attempt at reparation in the wounded parts. An unusual appearance was seen at the base of the cavity, and, resting upon the diaphragm; a shining elastic swelling occupying the whole of the lower half of the cavity. This was found to consist of the stomach, duodenum, and a portion of omentum. The finger could not be passed from the thorax into the abdomen, and, on farther exploration, recent adhesions were observed between the diaphragm and extruded parts. There must have been considerable strangulation, although the opening was nearly two inches in diameter, and of a circular form. The mucous membrane of the stomach was intensely red and swollen, peeling off easily. The stomach was perfectly empty."

" *Queries.*—Was this one of the cases in which the bold and original suggestion of Mr. Guthrie, to cut down and relieve the incarcerated organ, should have been tried? Will the excessive thirst and vomiting help us in future cases to a diagnosis? Or will the site of the aperture or apertures assist us? In four out of six cases reported by Mr. Guthrie, two were between the ninth and tenth ribs, two between the eighth and ninth. The one now related was at the ninth rib."

The following note was appended by Mr. Guthrie to the above case. " I am not aware that more could have been done with propriety, unless perhaps the posterior wound had been more enlarged, so as to allow of no retention of fluid; but this would not have rendered any important aid in saving the life of the patient, the occurrence of the hernia not being suspected previous to the man's death. The operation I have recommended, of making an incision through the wall of the abdomen, for the purpose of dividing the structure of the diaphragm, and of withdrawing the parts protruded into the thorax, can, I fear, only be attempted with a hope of success in what may be termed secondary cases,—where the sufferer has recovered, with a hole in his diaphragm, through which, after a time, portions of the viscera of the abdomen ascend into the thorax, and become incarcerated in the first instance, and subsequently strangulated, from distension of the hollow viscera.—G. J. G."

It will be observed, that vomiting and excessive thirst were prominent symptoms. Similar symptoms are alluded to in a case reported in the *Lancet* of the 4th of July, 1828, page 421, "awful thirst" and "anxiety" are the terms employed. There are two cases of cure recorded in the *Medical Times and Gazette*, vol. xxxvi, page 199, and *Lancet* of the 4th of July, 1828.

Parée relates a case in which, at the autopsy, he fancied that the stomach was absent, but found it, in the thorax, distended with air. The stomach had passed through a hole in the diaphragm half an inch square. In another case, reported by the same surgeon, in which a ball entered at lower margin of the sternum, and passed out between the fifth and sixth ribs, the wounded man appeared after a time to have recovered, except that he had frequent attacks of colic, and dared not to eat a full meal. Eight months after the receipt of the injury, he died during a severe attack of colic.

A great portion of the colon was found in the thorax. The hole in the diaphragm was the size only of a pea.

The statement has been passed down by writers, that wounds affecting the tendinous portion are mortal; while those affecting the fleshy fibres terminate more favourably. Any one curious in this question will find a collection of such cases in Bonetus. It is remarkable that the diaphragm is not more *frequently* wounded, when we consider that, at the moment of a forced expiration, it may rise to the level of the fifth rib. The following case of wound of the œsophagus, given by Riverii, page 684, is the only one I have met with in my reading, and the minute description given of the symptoms will be useful for diagnosis in future cases :—

" Dominus de Roques, junior, Eques cognominatus, Salsæ obsidione vulnus ex sclopeto accepit in parte superiori et media sterni, quod oblique ad dorsum ferebatur, et sex digitis transversis à spina dorsi exitum habebat. Statim ab inflicto vulnere dolores punctorios, acutissimos in œsophago percipit; ac si spina illi partes infixus haberet, et quia a sanguine suffocabatur, maximis conatibus illum nitebatur excernere ; ac tandem post longos frequentesque conatus, multam sanguinis excretionem, quia plurimus pelves impleverat, dolor œsophagi punctorius omninò desijt. Post multos dies æger alvum deponendo, eosdem in ano dolores

sunt." Casserius, also, gives several instances of cure, also M. de Garengeot, also M. de la Martinière. No case of wound of the trachea came under my immediate care. In the Director General's *Report*, there is noted under "gun-shot wounds of the neck," only one hundred and twenty-eight men, and nineteen officers. The per centage in the former, to the total number wounded, viz. 12,094, being only 1·7; but, of these, only five had actual lesion of the parts; viz., one of the pharynx, two of the larynx, one of the larynx and œsophagus, and one of the trachea. Of these, one died, one went to duty, and three were invalided. The fatal case occurred in the wound of the pharynx. Of the nineteen officers, only three had actual lesion of the parts; two died, and one was invalided. The others were simple flesh contusions, and wounds. Certain cases, where neither the lungs nor large vessels were wounded, but rapid and fatal sinking occurred, may be explained by the supposition that the thoracic duct had been injured. No special case of wound of the par vagum or other thoracic nerve is noted.

CHAPTER XIII.

ON THE TREATMENT OF PENETRATING WOUNDS OF THE CHEST.

This division of the treatise will be discussed under the heads of Local and General Treatment.

1. Local Treatment.—In order to detect the foreign substance known or suspected to be lodged in or about the thoracic cavity, a very careful exploration is to be made; but the less probing and poking the better, unless obvious reasons demand manual interference. As far as regards the probable presence of splinters of bone, we may be somewhat guided by observing whether the ball or projectile has passed through the cartilage, or the solid osseous portion of the rib or ribs; in the latter, the presence of splinters is more to be apprehended than in the former case. John Bell, at page 281, says: "The finger should always be introduced gently; and this way of probing should never be repeated, unless when we are sensible of there being many splinters of bone." Erichsen, at page 296, says: "In these cases, if the surgeon

be in doubt whether the cavity of the chest has been opened, it is better for him to wait and be guided by the symptoms that manifest themselves, rather than probe the wound, and run the risk of converting it into what he dreads,—a penetrating wound of the chest." I fully agree with these judicious cautions; for there may be more danger in attempting to remove the foreign body, than in its retention, seeing the lengthened periods during which bullets may remain innocuous in the human body. Larrey mentions cases in which he has seen bullets coughed up after long retention; and Louis (in his second memoir on *Bronchotomy*), speaks of portions of "tents", and even fragments of ribs, having been expectorated.

A remarkable case is reported in the *Lancet* of the 9th of January, 1847, by Mr. Moore of Plymouth, in which a ball had lodged near the surface of the lung for fifty years. Boyer relates a case in which the ball lodged for twenty years. There are three cases mentioned by Baron Perry (*Manuel du Chirurgien d'Armée*, Paris, 1772, p. 125); also two cases by Larry (*Relation Chirurgicale des évènements du Juillet*, 1830). In vol. xiii, page 281, of the *Transactions of the Medico-Chirurgical Society*, a case is related where a piece of iron hoop remained in the chest for fourteen years; also the case of Barrott, mentioned at page 59. In the following case the party showed no inconvenience from a ball apparently lodged.

Case 29. Patrick Flanagan, aged 34, 97th regiment, wounded on the 8th of September. Ball entered at and fractured the eleventh right rib, and apparently lodged. Pulse 92; respirations 32; great nervous agitation. Ordered a large opiate.

Next morning he was calm, and made no complaint of pain or uneasiness. Pulse never rose above 80; and on the 13th of October he was sent convalescent to Castle Hospital at Balaklava.

It is stated in the Director General's *Report*, page 63, "It seems very doubtful if every case in which the ball was fairly lodged within the pleural chest lining, did not die." There are three cases alluded to of recovery under this deplorable contingency; but the *Report* goes on to say, they "may be considered open to great doubt as to whether the ball had actually penetrated". Sharing as I do in these doubts, the cases Nos. 24, page 62, 29, just related, and 30, page 85, would nevertheless favour the possibility of recovery in cases of lodgment. It cannot be denied, however, that, *cœteris paribus*, it is advisable to remove the foreign substance, if it were for no other motive than the great peace of mind which this event invariably induces in the patient; and there are also cases in which the presence of the ball or foreign substance has been productive of serious mischief and danger to the wounded man. The instructive details of the following case, which occurred when I was doing duty at the Camp General Hospital, supplied to me by Dr. Alexander Smith, staff-surgeon, 1st class, fully illustrates this point.

"Patrick William Keane, of the 97th regiment, aged 26, was wounded on the 8th of September, at the attack on the Redan. He was in the act of loading his piece when he was struck by a bullet, which passed through the outer side of the left elbow joint, from behind forwards, injuring the head of the radius and the articulating extremity of the humerus. After passing through the joint, the bullet lodged in the left side of the chest, impacting itself between the ninth and tenth ribs. The joint was resected by the H incision, the longitudinal parts of which healed by the first intention; and, in little more than a month, the whole completely cicatrised, there never having been an untoward symptom, so far as the arm was concerned, beyond a slight threatening of sloughing, which occurred at the upper margin of the lower flap. No inconvenience was experienced from the bullet, and the wound in the side had gradually contracted into a small fistulous opening.

"At the end of six weeks, however, and when he had been up and about for several weeks, he was suddenly struck down by symptoms of acute pleurisy in the left side of the chest. There were the sharp pain and difficulty of breathing, accompanied by fever, and soon followed by dulness on percussion over the lower part of the side. There was slight displacement of the heart towards the right side, and, at a later period, the extremities became œdematous. Soon after the commencement of the above symptoms he began, for the first time, to suffer from attacks of a convulsive cough, of so violent a character, and at times of so long duration, as to endanger life. During the paroxysms, he expectorated large quantities of frothy mucus, and on one occasion brought up about a tablespoonful of florid blood. Under the treatment usually directed against pleurisy, and the free use of anodynes, given so as to anticipate the occurrence of expected paroxysms of cough, the pain gradually abated, the difficulty of breathing and fits of coughing became less urgent, and the swelling of the hands and feet subsided; the left side of the chest at the same time became visibly flattened."

"Within a few days of the commencement of the pleuritic attack, the wound of the side healed and remained closed for several weeks. At the end of that time, however, it again began to discharge, and, on examination by the probe, the opening was then found to lead, not in the course of the original wound between the ninth and tenth ribs, but downwards over the tenth rib, to the space between that and the eleventh, where the bullet was detected, cut down upon, and removed. On the man's admission into hospital, the finger could detect a small flattened surface or the bullet at the bottom of the wound between the ninth and tenth ribs, but so deeply and firmly was it impacted, that it was deemed advisable to defer interference for its removal, until pleuritic adhesions had been set up in its vicinity. On its removal, the bullet was found to have been flattened into the shape of a wedge, having for its butt-end the smooth flattened surface felt at the bottom of the wound on admission. When it was removed, the narrow point came first, and projected between the tenth and eleventh ribs. It is therefore reasonable to infer that the wedge-shaped piece of lead entered with the pointed extremity first between the ninth and tenth ribs, eventually dropped into the chest with its point downwards, and, resting against the next lowest intercostal space, gradually advanced through it, in the usual manner, until it came within reach of the extracting forceps. After removal of the bullet, the wound rapidly healed, and the man was invalided to England in about three months from the receipt of his wounds, having regained strength, and with an arm which promised to be but little impaired in efficiency."

That the happy medium between interference and non-interference is not always arrived at, is shown by an amusing instance related of a gallant officer who, having been subjected for a considerable period to the rather rough but well-intentioned pokings of his surgeon, calmly inquired, "What are you doing?" The reply, "searching for the ball," was met by a gruff but pardonable ejaculation, "I wish you had said so earlier, because you will find it in my waistcoat pocket."

This caution would not appear to apply, however, to old cases; for in the *British and Foreign Review* for January 1858, page 266, an American case is reported, wherein the pleural walls seem to have borne with impunity an extraordinary amount of rough usage. Verily, the sensibilities of our cousins seem to be roughened.

CHAPTER XIV.

LOCAL TREATMENT OF PENETRATING WOUNDS OF THE CHEST (CONTINUED).

IF the local treatment of penetrating wounds of the chest could be based upon mechanical laws such as Stromeyer has laid down, viz., "To prevent ingress of air, and obviate inflammatory action", the extent of the wound would be the first consideration, and our success in the treatment would be commensurate with the small or large implication of the vital organs; but unhappily such is not the case. When there is only one opening into the thoracic cavity, and no missile lodged and the lung not collapsed, the primary treatment will be, to remove from the wound all jagged sources of irritation, such as spiculæ of bone or foreign matters, and, if need be, to cut down upon and remove the broken ends of ribs. The ancients approved of this practice; and Albucasis gives a drawing of an instrument called "Meningophylax", used to protect the subjacent membrane during the operation; then lay on the wound a pledget of lint soaked in cold water, and enjoin absolute rest, and be guided in the administration of food and stimulants by the state of the patient.

If the lung, although unwounded, should have collapsed, the immediate indication will be, to restart it into action before it becomes permanently attached by pleuritic adhesions to the posterior walls of the thorax. This may be attempted by closing the wound as much as possible, and applying emplastrum plumbi, spread upon leather; but a happy consummation is not often granted. The plan appears very well in theory, but in practice is unsuccessful. The air, if it be ever absent, will find admission into the thoracic cavity, and serum or blood will be poured out, inducing the very evil we desire to avoid, and compelling an immediate removal of the plaster to allow the exit of the fluid.

I cannot subscribe to the very easy matter made of this part of the treatment by S. Cooper. He says: "After a few days, the wound in the collapsed lung is closed by the adhesive inflammation, so that the air no longer passes out of it into the cavity of the chest, and the outer wound may therefore be healed." Such statements tend to lead practitioners astray, by a supposition of the ease and success of the treatment. When we perceive that blood is being poured out from the wound, an examination should be instituted to ascertain if the blood proceeds from a wounded intercostal artery. If such be the case, an attempt must be made to arrest the bleeding by pressure. In case No. 13, this proceeding was partially successful.

Several writers have indulged in lengthened descriptions of the modes by which this hæmorrhage may be arrested, a full list of which is to be found in Cooper's *Dictionary*. Gerard's plan appears the best. He introduced by the wound, as far as the upper edge of the rib corresponding to the wounded artery, a curved needle armed with a strong ligature, to which was attached a dossil of lint. The needle was then passed outwards, with its ligature, and the dossil of lint brought over the wounded vessel, and, by tightening, sufficient pressure was obtained. Hæmorrhage from this cause, however, is very rare, or, perhaps, this cause may not be detected; at all events, Mayer, Stromeyer, Larry, and others, wrote of its rarity; also, in the Director General's *Report* only one instance is noted, at page 66, Captain F. S., 9th regiment. Only one case came under my own observation, viz., No. 13. If there should be two openings, and one in the posterior or lateral surface of the chest, the accumulation of fluid is to be prevented by posture, for the fluid will gravitate and drain out continually. Under such circumstances, the anterior wound may be closed with safety. The advantage of closing the wound will be greatest in punctured wounds, where the edges are more or less in apposition; or when the bullet-hole is small, and the entrance of air is restricted. But when the missile is large, and the soft parts torn and the ribs splintered, and an opening made sometimes large enough to admit an ordinary sized walnut, little if any benefit will attend this procedure.

Hæmorrhage, with the older and with many of the modern writers, is held to be a great source of danger in lung wound, and in its arrestment the chief element of success is held to be venesection; to what extent this theory is correct remains to be proved. In my experience, the surgeon is seldom called upon to control "primary hæmorrhage"; for, if it be great, the wounded man expires before help can be accorded. In those cases where the hæmorrhage is into the thoracic cavity, Valentin, Larrey, and Bauden recommend that it should not, unless impending suffocation approaches, be evacuated, as its pressure on the open vessels will become the best and easiest styptic or ligature. To further this object, M. Duret has suggested that a large opening should be made into the chest, to cause collapse of the lung by the sudden irruption of air. This proposal, to allow the effused blood or serum to remain in order that it may act by pressure in arresting hæmorrhage, does not receive much encouragement from the following case; and there are many other cases noted, showing that a very frequent cause of a fatal result has been the pressure of a large effusion, arresting the action of the lungs.

CASE 17. Thomas Smith, aged 26, 30th regiment, wounded on the 8th of September. Ball entered fleshy part of right thigh. Cut out. Another ball entered at acromial end of right clavicle. Exit at angle of ninth rib. Great depression: hæmoptysis.

12th. Sudden effusion of blood and serum into right pleural cavity: death almost instantly.

No *post mortem.*

On the contrary, it happens in many cases of wounds of the chest, that the serum escapes freely by one wound, or, if there be two wounds, by both. This will be an indication to the medical attendant, to assist nature's remedy by enlarging the wound; and if the complete evacuation of the fluid cannot thus be effected, to entertain the necessity of forming an artificial opening by paracentesis thoracis. Opinions as to the point of election for the introduction of the trocar vary. Baudens recommends the eleventh intercostal space close to the spine; but generally between the fifth and sixth rib, if it be the right side, and between the seventh and ninth, if it be the left side, are the points selected. The following case, given in the Director-General's *Report*, page 65, shows certain peculiar effects which may attend this otherwise simple operation; and they ought to be held in remembrance by the medical attendant as a possible contingency.

John Carroll, aged 20, 97th regiment, wounded on the 8th of September. The ball appeared to have entered and lodged in the chest. Urgent symptoms of pleuro-pneumonia were present. Calomel and opium were prescribed on the 22nd. At a spot close to the inferior angle of the right scapula, "something was detected which had much the feel of a bullet. It was cut down upon, and found to be one end of a fractured rib, and it was now evident that the cavity of the chest had been unintentionally opened ; a considerable quantity of darkish bloody serum flowed through the wound. The operation was immediately followed by a most distressing and alarming dyspnœa, as well as excessive increase of the pain. He tossed his arms wildly about, appeared to be quite unable to breathe, and death to be imminent. The wound was closed, and a bandage applied with some relief; but much pain and dyspnœa remained, and constantly increased if the bandage was relaxed. He died three hours and a half after the opening had been made. Two pounds of dark-coloured clotted blood, and a large quantity of serum, were found in the cavity of the chest. Three ribs were broken ; the two upper very badly ; the lower the one which had been cut upon. The lung was compressed, bloodless, and unwounded. The bullet (conical) was found lying on the crus of the diaphragm."

The report goes on to observe : "The suddenness of the death seems difficult to account for. He did not die of hæmorrhage. The blood found in the chest had not come from a vessel wounded in the operation. His appearance did not give the idea of blood-poisoning by asphyxia."

A case similar in result, from opening the chest, is recorded by Dr. Hoadley, page 70, as having been seen by him in St. George's Hospital. "A girl, about three years of age, had a small swelling on the back, situated on the lower small ribs on the right side, about the bigness of a walnut. The swelling was soft, and plainly contained matter. . . . . Upon opening this tumour, there came out a surprising quantity of matter, the discharge of which affected the child's breathing so much, and occasioned such an alteration in the manner of performing it, that the surgeon was forced several times to stop the orifice with his finger to give her time to recover her breath." In this, as in the former case, it is not easy to give an explanation of the cause of the urgent dyspnœa induced, by that which is now known to be a very simple and, in general, a safe operation, unless the following will suffice. By a law of hydrostatics, the fluid in the thorax is pressing equally on all sides: and at the smallest removal of opposition to such pressure, such as cutting down upon a rib, a release will follow, and the constrained lung will rise to follow the expanding chest-wall, and urgent dyspnœa will follow.

The following case, under the care of Dr. Ranke, presents subject for reflection connected with the present point. The bullet entered above the left clavicle, slightly splintering its upper edge. Supposed exit between sixth and seventh ribs. An elastic swelling, as large as a turkey egg, appeared at the supposed point of exit upon expiration and the act of coughing, and disappeared upon inspiration. Symptoms of pleuro-pneumonia, and also "metallic tinkling," are said to have been present. Recovery took place. It is doubtful whether the lung really was wounded. The ball may have passed between the pleuro-pulmonalis and costalis, and at the point where the swelling appeared, ruptured the fibres of the intercostals, thereby admitting a hernia of the lung. The ball must have lodged. See a resembling case by Sabatier. Dr. Halliday reports a similar case, page 26, and puts it down as emphysema. "The swelling," he says, "contracted on inspiration and expanded on expiration." The question here arises, if an apparent necessity arises for opening a similar tumour, are we to be deterred from interference by a fear of inducing effects similar to those described in the two foregoing cases? I think not; they were clearly exceptional, from a peculiar idiosyncrasy, or some physiological or physical influence.

CHAPTER XV.

ON THE GENERAL TREATMENT OF PENETRATING WOUNDS OF THE CHEST.

In entering upon the general treatment of penetrating wounds of the chest, it is necessary, for a full comprehension of the subject, to premise that the circumstances in which the British soldier was placed in the Crimea were those of great hardship, arising from deficient and unwholesome food, inclement exposure, undue excitement, excessive and prolonged exertion: all of which tended to reduce him to a state of extreme moral and physical depression, and, in many instances, to a condition of positive anæmia and irrecoverable exhaustion. It is scarcely necessary to add, that in this condition men would be ill able to bear up against the ravages of disease and the destructive effects of wounds.

My observations on the general treatment will mainly apply to the non-utility of venesection in cases of lung wound; and in my endeavour to arrive at a useful and practical conclusion, the inquiry is suggested, What is inflammation? I mean the causes, not the effects; for the "dolor," "calor," "tumor," et "rubor," however elegant in diction as a definition, express the effects only of inflammation. The remote causes of inflammation are still unknown; and the increased means of diagnosis by the microscope have failed to unveil the mysterious process, or demonstrate a difference between an inflammatory or non-inflammatory morbid deposit. The definitions of Drs. Alison and Bennett, the rival champions, do not enlighten the darkness. The former says, "Exudation of lymph is essential to almost all changes of structure produced by inflammation." The latter says, "I understand inflammation to be an exudation of the normal liquor sanguinis." It is pretty certain that the amount of fibrine is increased in the blood, and that there is a diminution of the red, and an increase of the white corpuscles of the blood.

The proximate cause of inflammation appears to be a relaxed condition of the capillaries, causing them to admit red blood corpuscles, to which they are impervious in their normal condition. However, Wedl, at page 22, says, "This contraction and dilatation of the lumen of the capillaries is problematical."

Another important element in this inquiry is, the effect produced on the physico-chemical character of the blood by venesection. There are, however, discrepancies of opinion as to the alteration of the blood consequent on depletion.

Polli states that the fibrine is increased, and that the red globules and albumen are diminished. *Andral* states that the fibrine is not diminished at once, but that the number of red globules is immediately reduced. *Kölliker* holds the same opinion. *Ancelli* states that the fibrine is diminished.

We are thus stopped by these discordant statements at the threshold, and drawn to follow the less attractive, but more useful process of inductive experience.

Until recently, venesection was universally, and by many is still, considered the "*sheet anchor*" in the treatment of "Penetrating wounds of the chest", in order to arrest a dreaded train of pneumonic symptoms. Stromeyer, in his writings on the Danish War, expresses regret that Dr. Schwartz should hold the opinion that bleeding is not always necessary in lung wounds. This observation may fairly apply to the case of Hannihan, reported by Dr. McLeod in the *Edinburgh Monthly Journal*, vol. ii, page 192. The experience of the late Mr. Guthrie induced him to practise, and strongly advocate, large and repeated venesections in all cases of "Penetrating wounds of the chest". In this opinion he derives support from more recent writers. Mr. Erichsen, at page 316, says "the most experienced surgeons are unanimous in their opinions that at this stage of the injury the patient's safety lies in full and repeated venesections." Sir Astley Cooper says, "it (bleeding) is, in fact, the only chance left of saving the patient from suffocation, although stimulants are required to counteract its effects." Bransby Cooper, at page 102 of his *Lectures on Surgery*, says: "Under all circumstances of wounds of the chest, the great desideratum is to diminish the quantity of blood sent to the lungs; this object is obtained by bleeding, which must be freely employed, repeating it to the utmost so long as blood is coughed up, and the dyspnœa urgent, even to the verge of danger from its use." Dr. Ballingall writes still more strongly at page 317: "The surgeon's object must be to diminish, as far as consistent with life, the quantity of the circulating fluid."

Illustrative of the undue influence of these opinions, may be given the case of Private John Dolan, related at page 64 of the Director General's *Report*. Both pleuritic cavities were opened. The surgeon says: "Bleeding was not adopted in this case, on account of the weakness of the pulse and anæmic appearance of the patient." Here we have actually a surgeon, of superior judgment, who deems it necessary, almost, to apologise for not doing, according to routine, a murderous act.

In again referring to Dr. McLeod's "notes," I have pleasure in saying that, although his opinion is at variance with my own, he having been upon the spot, any observations from him demand attentive consideration. I may observe, that as the doctor's care was not particularly devoted to "wounds of the chest," his illustrative facts cannot be numerous. He says, at page 237: "But, I think, it was very generally observed, that those cases did best in which early, active and repeated bleedings were had recourse to." Nevertheless, a case reported by him at page 241, in his own practice, gives no favourable proof of the benefit of depletion. No signs of acute pneumonia are stated to have been present; the solidified state of the lung was the consequence of pressure from fluid. In a case published by Mr. Hole, in the *British Medical Journal*, of the 7th of August, 1858, venesection is highly lauded, because recovery took place; whereas, the only proof given that the substance of the lung was wounded was the fact "that air escaped with every expiration, thereby clearly indicating the passage of the ball through the lung"; the rationale of the treatment is consequently erroneous. Three cases are related by Mr. Mackay, of 2nd Battalion of the Royals, vol. i of the *Edinburgh Medical Journal*, page 924. It is more than doubtful whether the lung was wounded in the case of Duffy; the urgent dyspnœa, which was supposed to require venesection, was caused by the emphysema acting mechanically upon the walls of the thorax; fortunately the patient did not suffer by the loss of forty-eight ounces of blood. The termination of the case of Mulreahey not being given, no conclusion is derived from it. The case of Sweenly is clear. The lung was wounded; the repeated bleedings did not prevent a fatal issue.

To pursue this subject, pleuritis and pneumonia are generally considered to follow penetrating wounds of the chest. In proof of this, a recent writer, Mr. Erichsen, says, at page 298, "Pneumonia is an invariable sequence of a wounded lung"; and again, in same page, "Traumatic pneumonia resembles, in all its symptoms, auscultatory as well as general, the idiopathic form of the disease. There is the same crepitation, dulness on percussion, and absence of respiratory murmur, as hepatisation advances, with rusty sputa, much tinged with blood in the early stages. It differs, however, from the idiopathic form of the disease, in having a less tendency to diffuse itself throughout the lung, in being limited to the injured side alone, and in more frequently terminating in abscess, which, however, is often dependent on the lodgment of some foreign body in the substance of the lung." Dr. Watson, on the other hand, says that there is "a marked difference between fevers and common inflammation occurring in a previously healthy person. In fevers, the blood is primarily diseased. In inflammation, it is the part inflamed which gradually spreads infection through the general mass of the blood; and this contamination we prevent, or limit, if we can arrest the inflammation."—Watson, *Monthly Journal of Medicine*, vol. ii, p. 1087.

This argument, admitting the difference alluded to, will not apply in the case of wounds, if, as alleged, idiopathic be different from traumatic inflammation.

If the so-called pneumonia, following upon chest wounds, be of the true inflammatory type, excessive depletion would, even then, be of doubtful propriety, as an excess of fibrine is not much affected by copious bleeding, even when frequently repeated; and the red corpuscles are certainly lessened in number, rendering exudation easier, and as Travers, at page 59, says, "We cannot prevent inflammation by bleeding before its advent." This is an observation made by an acute observer, and without reference to a preconceived theory. Let us see how it is practically, but unintentionally, proved. The following case is reported by Dr. McLeod in the *Edinburgh Monthly Journal*, vol. ii, page 54: "A soldier of the Buffs was wounded on the 8th of September by a ball which entered his chest on a level with, but external to, his right nipple. The ball was lost. Profuse hæmoptysis, fainting, great dyspnœa, oozing of blood from the wound, and the escape of air followed. He was largely bled, and his symptoms were thereby greatly alleviated. Ten hours afterwards, a return of the dyspnœa called for further depletion and the use of antimony. *Pneumonia followed*, and the lower half of the lung was seriously implicated."

The italics are by the author of this Treatise. No further commentary is necessary to show that bleeding will not prevent pneumonia. Case No. 10, reported by the same gentleman at page 197, leads to the same conclusion. Marshall Hall says, on the subject of bleeding, in a paper read before the Medico-Chirurgical Society on the 23rd of November, 1824, and published in the 13th vol. of *Transactions*: "The symptoms of exhaustion with reaction have, I am persuaded, frequently been mistaken for those of inflammation. Under this impression, recourse has frequently been had to the further detraction of blood by the lancet, and the effect of this practice is such as greatly to impose upon the inexperienced: the symptoms relieved are those of reaction."

A passage in No. 1, page 177, of Copland's *Dictionary*, bears closely upon this subject, but it is too long to transcribe; also Carpenter, at page 134, speaks to the same opinion. There can be no doubt that this reaction is generally "asthenic," or, in other words, the effects of the previous depletion.

Connected with this subject—viz. whether venesection is always necessary in cases of chest wounds—is the important question, but which can be only most cursorily dealt with here, whether there is a change in the type of disease, or, in the words of Sydenham, the "constitutio morborum stationaria", or whether there is an actual and progressive change in the constitution of the mass of mankind, which, in the treatment of alterations from a state of health, requires the employment of stimulative, and the avoidance of depletive, measures: or whether, as Dr. Bennett says, our improved knowledge of physical diagnosis has taught us to recognise, with greater accuracy, the advent of inflammatory action.

If our improved means of diagnosis be the sole reason for the change of treatment which has arisen within the past thirty years, taking pneumonia as "le cheval de bataille", how comes it, that, in those inflammatory affections, for the detection of which no "improved knowledge of diagnosis" is claimed, viz. "cerebritis", "peritonitis", "cystitis", etc., etc., venesection has been found in the present cycle to be equally inimical?

Dr. Markham has recently promulgated peculiar opinions on this subject. I am not prepared to endorse the general principle propounded by him, that venesection is useful, only so far as it relieves cardiac congestion. In the illustration that this prolonged cardiac congestion explains the benefit of venesection in wounds of the lung, he assumes, like many writers, as a fact that which is very problematical. If a lung, or lungs, are thrown out of use, and consequently a diminished quantity of blood passing through it or them, the right side of the heart cannot become congested, because there is a lessened quantity of blood being poured into it; and, therefore, according to Dr. Markham, venesection relieves an evil which is not present.

It has been said that bleeding lessens the necessity for decarbonation; also the number of inspirations. I can give no opinion as to the former, but I am certain that the latter statement is incorrect.

So far as the data contained in this Treatise will warrant a conclusion, it would appear that pneumonia is very infrequent in wounds of the chest. Even if it were a common sequence, there would still be grave doubts as to the propriety of practising the large and repeated bleedings, so strongly recommended by the writers quoted. Statistics have failed to show the great benefit of depletion: indeed, they show the contrary. In the Director-General's *Report*, it is shewn that, out of eight fatal cases, two were bled, and these died the most rapidly of all. In the Crimea many of the wounded men were just in the condition in which only asthenic diseases, such as a low or typhoid form of pneumonia, could arise. This low inflammatory type characterized the progress of all classes of wounds in the Crimea, as shewn by Dr. Matthew; also by Mr. George Lawson, in his very interesting paper on "Gun-shot Wounds of the Thorax". I am gratified to observe that the observations of both those gentlemen have led them to conclusions nearly, and in some cases entirely, similar to those I have formed. This agreement of opinion, arrived at under similar circumstances, with similar data, and a total absence of all collusive views, has greatly strengthened my statements. Under such an anæmic condition of system, it is certain that venesection will act upon the injured organs with an effect proportioned to their impaired "*vis vitæ:*" and, although after venesection there may be less blood circulating, there will be, in an equal ratio, less power of resistance to morbid actions; and a greater evil, viz. "irrecoverable exhaustion", will arise, than if there were more blood and more strength.

CHAPTER XVI.

ON THE GENERAL TREATMENT OF PENETRATING WOUNDS OF THE CHEST (CONTINUED).

WHEN certain of the textures or organs of the human body are injured by accident or wound, the reparative process ought not to be interrupted by any additional shock to the system, such as depletion. Excessive depletion weakens, if it does not actually destroy, the vital power, and arrests the motions of which inflammation is a consequence, and which changes, or motions, are required to produce the act of reparation.

The effect obtained by bleeding in chest wounds is held to be, 1st, the arrestment of the primary danger, hæmorrhage. Those writers, Ballingall for instance, at page 309, who recommend bleeding as a means of arresting hæmorrhage, have failed, both practically and theoretically in sustaining the position. It is difficult to understand how the taking of blood from the basilic vein can arrest hæmorrhage proceeding from an intercostal, mammary, or other artery; or directly diminish the relative amount of blood sent from the heart by the great pulmonary artery to the lungs; for if it be true that the velocity of the blood is increased in the vein opened and those adjacent, the velocity of that fluid must be proportionately increased in the arteries, and an increased quantity will be thrown out at the wounded vessel. (See *Dissertation on the Blood*, by Alb. Haller, pages 92 and 102.)

2. The prevention and reduction of inflammatory action. Inflammation, as the term is generally understood, is a most rare event in lung wounds; and consequently venesection is uncalled for, often injurious, and sometimes dangerous. The cases which demand bleeding are those in which the pulse conveys to the fingers of the medical man the sensation of a full labouring and oppressed pulse. If we practise venesection in order to lessen the absolute quantity of blood, the chances are that we shall kill our patient; and we are certain to be led into serious error if we depend, as many do, upon the indications given by the state of excitement in the circulation; under such circumstances it is no measure, for it may be present when the wounded man is in a state of debility and exhaustion. It may be, therefore, fairly considered that venesection is not demanded on any sound argument.

Irrespective of the physiological argument, which goes to prove that the effects produced by wounds, usually considered as of an inflammatory character, are not so; many of the cases on which the argument for the success of venesection is based, were, probably, not wounds of the lung at all; and, by the excessive depletion, if not immediate mischief, at least a tedious convalescence was inflicted. Both John Hunter and Bell state that in cases of depressed soldiers, bleeding after wounds must be employed cautiously. John Gooch, at page 361, writes, "Bleeding is to be used with great caution, lest we sink the patient too much."

Let it be admitted that the diagnosis in certain of my cases may have been at fault, and that pneumonia may have been present; it is nevertheless certain that it involved only a very limited portion of the lung: and, under such circumstances, it is admitted even by the advocates for depletion that large bleedings are not required, and, if not required, must be positively injurious. I am bound to refer, while on the subject of treatment, to our old friend Francis Anceas. He says: "It shall be needefull also to open a veine, first on the contrarie side, and then on the same side . . . . and considering the strength of the patient. It is expedient also for such a decoction to be prepared, that his breathing may be mended, and made more facile, for the same is meate, and medicene, and drinke, whereby the wound is most refreshed." The learned prescription is at page 26 of his most excellent and compendious method of curing wounds, and shows the sagacity of the prescriber in the blandness of the physic.

If bleeding be ever advisable in lung wound, the jugular vein is the one to be opened; for, according to Alb. Haller, page 92, "Bleeding in the jugular emptieth the heart, the right auricle, and the lungs." This is the old doctrine of the *vis vitæ*, which taught that each organ possessed the power of regulating its activity to the required supply of blood.

The opinion of Dr. Alison, although in the present instance he is not writing of wounds, is to be noticed, as a most cautious one. "I will not say that the bleeding may not, in some, have been injurious (in pneumonia), and part of the cause of death . . . but, because the bleeding was too large, and because it came too late for the cure." *Edin. Monthly Journal*, vol. i, page 782

It is certain that, notwithstanding Mr. Guthrie's strong advocacy of depletion, he was not always satisfied as to its beneficial effects; but foreshadowed, from his own practical observations, certain matters of detail, which in some sense may be considered as sufficient to upset his own leading precept. Thus, at page 412 of his *Commentaries*, he says: "If the heart and pulse are both weak, the abstraction of blood will almost always occasion complete prostration of strength, and may be fatal"; and, at page 439, he quotes Lord Beaumont's case, and says: "He lost more than one hundred ounces of blood within a month; fortunately for the patient, on one occasion only four ounces could be obtained, and he recovered, but at the expense of an empyema, and thanks to an iron frame." Also, at page 484, he quotes a case, where, "in spite of the most vigorous antiphlogistic treatment, death occurred in a few days": and, in giving the case of Mr. Drummond, who was accidentally assassinated, and who was largely blooded, the abdomen was found distended with blood, "from some small vessel, which had sloughed, the blood being partly coagulated, and partly diffused, to the extent of many ounces", he makes this remarkable observation: "It's (the blood) loss appeared to have been the immediate cause of death." The corollary to this is evident: also in a paragraph at page 430, he displays a very qualified opinion.

Various other writers give cases where the fatal event was clearly traceable to excessive venesection, Hennen and John Bell especially. The latter writes as follows, at page 282 of his *Treatise on Wounds:* "The first danger of suffocation is now over, the bloody expectoration has ceased, the strength is reduced to the very lowest ebb, more, it should seem, by our bleedings than by the wound": and the same author, at page 239, while writing on the first effects of a wound, says, "This is no time for bleeding, whatever the nature of the wound may be": and at page 241: "But in every wound there comes a period of weakness, in which we repent of every bleeding that we may have made, even when it was needed."

There is somewhat of contradiction in the following paragraph, at page 260: "It is only by these repeated bleedings that the patient can be saved; the vascular system must be kept low in action, and so drained as to prevent the lungs from being oppressed with blood": at page 259 and 308, he again advocates bleeding very strongly, but significantly adds, "reckoning to pay dearly for the present bleedings in some future period of the cure." This is the "anceps remedium" with a vengeance. The argument of this distinguished man, that by bleeding "there will be less danger of immediate suffocation in the lungs," can scarcely be maintained; nor can we subscribe to Samuel Cooper's opinion, that "it is better, and more advantageous for all patients, that some of them should lose blood, perhaps unnecessarily, than that any of them should die in consequence of the evacuation being omitted or delayed."

It is a remarkable coincidence, that the case of Mr. Winter, related by Mr. Guthrie at page 430, as illustrative of the advantages of bleeding in wounds of the chest, should have been the first case which shook my belief in the benefit said to arise from venesection.

Mr. Winter came under my notice on the day he was wounded, and he was, as stated by Mr. Guthrie, largely blooded, the surgeon having been guided by the then prevailing opinions. The author is now more than doubtful whether the substance of the lung was wounded, and thinks that the large bleedings to which Mr. Winter was repeatedly subjected, induced the depression and wasting from the effects of which he never recovered, for the "Vires naturæ medicatrices" were completely destroyed. Those who witnessed this case, will remember the relief which followed the first bleeding, soon, however, to be followed by an inordinate vascular reaction, requiring, as was considered by the gentleman in charge, a repetition of the venesection. This was again followed by transient relief, and this again by a renewed reaction. The venesection was courageously carried out, but at the cost of an "empyema", and a broken down constitution. A case resembling Mr. Winter's is given in vol. x, page 60, *Trans. Royal Society;* also one by Larrey, page 266, in which excessive depletion was adopted, but death ensued 125 days after the wound.

In the *Medical Times,* of the 7th of December, 1844, page 231, a case of bullet wound is noted, in which nine pounds of blood were abstracted in twelve days; "but," the writer goes on to say, "notwithstanding this energetic treatment, the respiration became more and more difficult, and he sank on the 12th day." Another case of bullet wound is noted in the *Medical Gazette*, of the 22nd of May, 1835, where the unfortunate patient was certainly bled to death.

We ought truly to pause in our bleedings, after reading the foregoing, and also a case related by Mr. Lawrance, in which he makes this remarkable observation: "He was reduced by these means (depletion) to death's door; however, he was a young person, and it so turned out that the lungs had not received any serious injury."

There are several cases, however, recorded in which cures seem to have followed after large bleedings, always admitting that the lungs *were wounded.* Schmücker gives several illustrative cases; also, in vol. ix, page 204 of the *Transactions of the Medico-Chirurgical Society*, is a case of wound from a canister shot, in which the lungs would appear to have been wounded. Eleven pounds of blood were taken away in five weeks, and recovery ensued.

These illustrations will be concluded by a case related by the quaint Wiseman, at page 368, because of the moral to which it points. "A man had been wounded in the right breast, and coughed up much blood": he was bled, and the surgeon goes on to say: "By his disorder he frequently relapsed and coughed up blood at times. I let him blood as often, and left his wound open and digested; but he, relapsing again, *I began to be sick of him*, and dealt with him to send *for a physician;* Sir Edward Graves was consulted, who saw his wound almost cured. We repeated the venesections, and from that time he recovered."

In conclusion, the elements of treatment in [illegible] wounds of the chest may [illegible] substances [illegible] impracticable, [illegible] when [illegible] openings, [illegible] attempted; [illegible] may be closed [illegible] a fear of the admission of air which the old authors so much dreaded. Baron Larrey speaks highly of the advantages to be obtained from closing the wounds by means of adhesive plaster and appropriate bandaging, and gives several successful cases at *page 225*. When effusion has taken place, and [illegible] to escape by the wound, and unless we hope to arrest further hemorrhage by allowing the effusion so to compress the lung or the walls of the chest, and thereby arrest bleeding, the wound must be dilated as recommended long ago by *Heister*, *Le Maire*, Petrus della Certa; or make a *counter opening* as recommended by Larrey. In *none of my cases* was this necessary; the Minié rifle ball saves all this trouble, by making a sufficient opening, if any inclination of the body can be obtained for the passing out of the fluid. In some venesection was practised; in some calomel, antimony, opium, or stimulants, were administered, singly or combined; in some, absolute rest, and the utmost attention to diet, were alone strictly enjoined. In none of the cases in which emphysema appeared were scarifications required; but, from the evidence of Dr. William Hunter, the originator of the practice, and other writers, I should recommend scarifications in those cases in which the urgent dyspnœa appears to depend mainly on the constriction caused by the emphysema. In many cases nothing more is required than what is necessary in all—namely, absolute rest, cooling beverages, moderate nourishment, and avoiding over stimulation, as shown in the following case.

Case 26. Henry Fontaine, aged 25, 90th regiment, wounded on the 8th of September. Ball passed through left biceps muscle, striking the thorax, and making exit at, and fracturing, fourth rib and injuring scapula. Pulse 120; respiration 30. Ordered beef-tea and absolute rest. Febrile symptoms appeared from time to time, the pulse, on one occasion, rising to 120 and respirations 32; but on the 16th, all lung symptoms having disappeared, he was transferred to another hut, and was under the treatment of Mr. Rooke, for months, for the wound in biceps muscle.

N.B. This case seems to be reported, although with certain discrepancies, by Dr. McLeod, in his paper in the *Edinburgh Medical Journal*, vol. ii, page 53, under the name of "*Fountain*". The "*de-*

[illegible] consisted of liq. ammoniæ acetatis, [illegible] gr. [illegible]; mist. camphoræ ℥ii. [illegible]

[illegible] that the surgeon is not often [illegible] upon to attempt the arrest of hæmorrhage [illegible] wounds, inasmuch, if a large vessel is wounded, death is certain; but if an intercostal or mammary artery is wounded, which seldom happens, then surgical aid is demanded; but the tenaculum, and other similar aids, are not often available. Bleeding, mercurialisation, narcotism and depression by *antimony* and digitalis, the elements of treatment *generally* recommended, may, under special *circumstances*, and when guided by sound professional *skill*, become advisable; but no one or two, or all *conjoined*, constitute the "sheet anchor" in the *treatment*: while a routine or indiscriminate *application* of them is second only in [illegible] to the *injury* itself; because a rigid faith in their *necessity* leads to a false security and the [illegible] *neglect* of more important measures.

[illegible] blood or serum should collect from the absence [illegible] mode of exit, and the movement of the lung [illegible] be impeded, and if an adjustment of position [illegible] in causing the exit of the effusion, then [illegible] thoracis" should be performed, as [illegible] by Alexander Monro. No warning [illegible] not to delay, under the hope that [illegible] will be carried off by the urinary [illegible] which are related by Swammerdam and Monro; or not to allow the effusion to remain to act as a compress.

The following physiological summary, but professing to include only a few of the leading points connected with this important subject, will appropriately close this Treatise:

1. If the wound be small, there seems to be little, if any, alteration in the movement of the lungs, as the respiratory murmur may be heard, more or less distinctly, on auscultation.

2. When an opening is made into the thorax larger than the glottis, collapse of the lung will sooner or later, but not immediately, follow. The speed and danger of this event will be doubled, if an opening be made into each thoracic cavity.

3. It follows from No. 2, and has been otherwise proved, that when a wound is formed in a pleural cavity, of a size equal at least, if not larger, than the opening at the glottis, collapse of lung is not an immediate or necessary consequence. That under such circumstances, the lungs in the injured side may inflate, and that such inflation occurs during expiration, and not, as might have been expected, during inspiration.

4. That the thorax may be pierced by a cutting instrument or a bullet, obliquely or transversely, without wounding lung: *ergo*, two apertures are no proof that the lung has been wounded.

5. T[illegible]ical [illegible]ngestion of the lungs is [illegible] inflammatory action.

6. That simple opening of the pleural cavity in animals seems to be productive of little or no risk, and only very trifling inconvenience.

7. That in the human subject, as well as in animals, an actual wound of the substance of the lung is always, sooner or later, mortal, not from the effects of inflammatory action, but, in recent cases, from a sudden cessation of proper aeration in either the whole, or portions, of one or two lungs; or sudden hæmorrhage.

8. If a bullet or other missile be lodged in the thoracic cavity, and has not caused instant fatal effects, and the wounded man escapes also the secondary dangers, the ball or missile will become encased by a false membrane, and may remain innocuous for years in the human body.

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